

METROPOLITAN WATER SUPPLY, SEWERAGE, AND  
DRAINAGE DEPARTMENT,  
PERTH, W.A.

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COMMEMORATION VOLUME,  
1925.

Compiled under the authority of  
HON. ALEX. McCALLUM, M.L.A.,  
*Minister of Department.*



## FOREWORD.

**T**HIS VOLUME HAS BEEN COMPILED TO COMMEMORATE THE TURNING ON OF WATER FROM THE FIRST SECTION OF THE NEW "HILLS" WATER SCHEME AND TO RECORD THE DEVELOPMENT OF THE METROPOLITAN WATER SUPPLY, SEWERAGE, AND DRAINAGE UNDERTAKING FROM ITS INAUGURATION IN 1896 TO THE PRESENT TIME ∴ ∴

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**Minister :**

HON. ALEX. McCALLUM, M.L.A.

**Principal Officers :**

UNDER-SECRETARY	....	....	....	....	G. C. HAYWOOD, J.P.
ENGINEER-IN-CHIEF	....	....	....	....	F. W. H. STILEMAN, M.Inst.C.E.
ASSISTANT ENGINEER-IN-CHIEF	....	....	....	....	E. TINDALE, B.C.E. (Melb.), M.Inst.C.E.
ACTING ENGINEER	....	....	....	....	J. PARR, B.Sc., M.Inst.C.E.
RESIDENT ENGINEER, HILLS WATER SUPPLY	....	....	....	....	R. J. DUMAS, B.E., M.Inst.C.E.
ACCOUNTANT AND ASSESSOR	....	....	....	....	G. H. LONG.
SUB-ACCOUNTANT	....	....	....	....	C. M. TAYLOR, M.C.
ASSISTANT ASSESSOR	....	....	....	....	F. W. BERRY.
CLERK-IN-CHARGE, RECORDS AND CORRESPONDENCE	....	....	....	....	J. P. GOODWIN.
CHIEF DRAFTSMAN	....	....	....	....	E. C. B. BONE.
ASSISTANT DRAFTSMAN	....	....	....	....	A. E. HOPKINS.

## SYSTEM OF CONTROL SINCE INAUGURATION.

Period.				Nature of Control.			
From.		To.					
1890 .. .. .	1896 .. .. .	1896 .. .. .	1898 .. .. .	Perth Water Supply Company (Mr. Wm. J. George, Manager). Board: E. Keane, Esq. (Chairman); Messrs. T. W. Hardwick and J. T. Hobbs.			
1898 .. .. .	November, 1904 .. .. .	7th June, 1905 .. .. .	28th August, 1905 .. .. .	Board: W. Traylen, Esq. (Chairman); Messrs. Craig and Rennick. Board, administered by Minister for Works (Hon. W. D. Johnson, M.L.A.).			
8th June, 1905 .. .. .	29th August, 1905 .. .. .	7th May, 1906 .. .. .	16th April, 1909 .. .. .	Board, administered by Minister for Works (Hon. P. J. Lynch, M.L.A.). Board, administered by Minister for Works (Hon. F. Wilson, M.L.A.). Board, administered by Minister for Works (Hon. J. Price, M.L.A.).			
17th April, 1909 .. .. .	24th January, 1910 .. .. .	16th September, 1910 .. .. .	16th October, 1911 .. .. .	Board: J. Thompson, Esq. (Engineer-in-Chief), Chairman, and Messrs. W. T. Loton and M. F. Cavanagh. Department, administered by Minister for Works (Hon. F. Wilson, M.L.A.).			
25th January, 1910 .. .. .	16th September, 1910 .. .. .	16th October, 1911 .. .. .	23rd November, 1914 .. .. .	Department, administered by Minister for Works (Hon. H. Daglish, M.L.A.). Department, administered by Minister for Works and Water Supply (Hon. W. D. Johnson, M.L.A.).			
17th September, 1910 .. .. .	16th October, 1911 .. .. .	23rd November, 1914 .. .. .	26th July, 1916 .. .. .	Department, administered by Minister for Water Supply (Hon. P. Collier, M.L.A.).			
17th October, 1911 .. .. .	24th November, 1914 .. .. .	26th July, 1916 .. .. .	27th June, 1917 .. .. .	Department, administered by Minister for Water Supply (Hon. J. Mitchell, M.L.A.).			
24th November, 1914 .. .. .	26th July, 1916 .. .. .	27th June, 1917 .. .. .	16th April, 1924 .. .. .	Department, administered by Minister for Water Supply (Hon. Wm. J. George, C.M.G. M.L.A., J.P.).			
27th July, 1916 .. .. .	27th June, 1917 .. .. .	16th April, 1924 .. .. .	Date .. .. .	Department, administered by Minister for Water Supply (Hon. Alex. McCallum).			
28th June, 1917 .. .. .	16th April, 1924 .. .. .	Date .. .. .					
17th April, 1924 .. .. .	Date .. .. .						



## ACTS PASSED SINCE INAUGURATION.

Act.	Date Assented to.	Date Repealed.
Waterworks Act, 1889 .. .. .	4th December, 1889 ..	17th April, 1909.
Fremantle Water Supply Act, 1893 .. .. .	13th October, 1893 ..	16th December, 1899.
Metropolitan Waterworks Act, 1896 .. .. .	8th October, 1896 ..	} 17th April, 1909.
Metropolitan Waterworks Act, 1896, Amendment Act, 1898 ..	28th October, 1898 ..	
Metropolitan Waterworks Act, 1899 .. .. .	} 15th December, 1899 ..	(Not in operation.)
The Peppermint Grove, Cottesloe, and Buckland Hill Water Supply (Private) Act, 1899 .. .. .		
Fremantle Water Supply Act, 1899 .. .. .	} 19th February, 1902 ..	} 17th April, 1909.
Metropolitan Waterworks Amendment Act, 1902 .. .. .		
Metropolitan Water and Sewerage Act, 1904 .. .. .	16th January, 1904 ..	24th January, 1910.
Metropolitan Waterworks Amendment Act, 1904 .. .. .	1st November, 1904 ..	24th January, 1910.
Metropolitan Waterworks Amendment Act, 1905 .. .. .	} 23rd December, 1905 ..	{ Sections 3, 4, 5, and 6 only on 24th January, 1910.
Metropolitan Waterworks Amendment Act, 1905 (No. 2) ..		
Metropolitan Water Supply, Sewerage, and Drainage Act, 1909	21st December, 1909 ..	(In operation.)
Water Supply, Sewerage, and Drainage Act, 1912 .. .. .	17th December, 1912 ..	(In operation, except Section 21 which was repealed 8th November, 1913).
Water Supply, Sewerage, and Drainage Act Amendment Act, 1913	8th November, 1913 ..	(In operation.)
Sewerage Works Validation Act, 1918 .. .. .	11th March, 1918 ..	(In operation.)

## Area Covered by Department's Operations.

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The area covered by the Department's operations, which extends from Fremantle to Greenmount, and includes the undermentioned Municipalities and Road Districts, embraces 1,209 square miles, and is divided into two Water and Sewerage Districts (Metropolitan Water and Sewerage District and Armadale Water District), and five Stormwater Districts :—

MUNICIPALITIES (9)—Claremont, Cottesloe, East Fremantle, Fremantle, Guildford, Midland Junction, North Fremantle, Perth, Subiaco.

ROAD DISTRICTS (14)—Armadale, Bassendean, Bayswater, Belmont Park, Canning, Claremont, Cottesloe Beach, Gosnells, Greenmount, Melville, Peppermint Grove, Perth, South Perth, Swan.



# Financial and General Statistics.

	1896.	1925.
Capital Expenditure .....	Water Supply .... £323,703	Water Supply .... £2,162,771
		Sewerage .... 817,813
		Drainage .... 332,448
		Total .... <u>£3,313,032</u>
Accrued Income .....	Water Rates, etc. £10,431	Water Rates, etc. £140,811
		Sewerage Rates 64,852
		Drainage Rates 26,221
		Total .... <u>£231,884</u>
Expenditure, including Interest, Sinking Fund, Administration, and Engineering Operation Costs .....	£10,516	£247,841
Water Rate, in £ on Annual Values ....	1s.	1s.
Minimum Water Rate, per annum ....	20s.	10s.
Charge for Domestic Excess, per 1,000 gallons	1s. 6d.	1s.
Sewerage Rate, in £ on Annual Values	10d. (1912)	1s. 1d.
Stormwater Rate, in £ on Annual Values	5d. (1912)	5d.
No. Assessments .....	4,018	61,500
No. Metered Accounts .....	5,100	23,400
No. Officers on Salaried Staff .....	7	130
No. Licensed Plumbers .....	....	103

# The First Water Supply Systems.

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The supply for the settlement in and around Perth was, up to the early eighties, obtained from private wells and tanks, the only public supplies being two springs, one on the present Technical School site and the other in Mount's Bay Road. In 1860 a public fountain, still in existence, was erected by Governor Kennedy on the latter spring. During 1870 a local Engineer (Mr. Henry Victor) propounded a scheme for pumping water from wells at the foot of Mt. Eliza into a reservoir and reticulating the city therefrom.

Perth's first permanent supply was the result of an arrangement made on 21st October, 1889, between the "City of Perth Waterworks Co." (comprising Messrs. N. McNeil, J. Whittington, R. Reid, and W. McLean), and the Perth Municipality, whereby certain waterworks were to be constructed. The agreement was signed by the Mayor (Dr. E. Scott) and Mr. McNeil's Attorney (Mr. E. Keane), and was witnessed by the Town Clerk (Mr. W. E. Victor). The agreement was for 25 years; and the annual water rate was not to exceed 1s. in £, the Council having the right to purchase the works between the tenth and twenty-fifth year of agreement. The works, which were estimated to cost £116,574 and which included the Queen Victoria Reservoir (capacity 200 million gallons) on Munday's Brook in Darling Ranges, a 12in. trunk main from the Reservoir to Mt. Eliza (distance 17 miles), and a 784,000 gallon service reservoir on Mt. Eliza, with reticulation pipes, were commenced in February, 1890, and water was first supplied to Perth in October, 1891. After construction a further agreement was made on 4th December, 1891, between the Mayor and Company, declaring the paid up capital at £150,000 and the purchase price at £200,000. This agreement was signed by the Mayor (Mr. E. Keane) and Company's Chairman (Mr. W. McLean) and Director (Mr. J. Whittingham). In 1896 the Government purchased the works under "The Metropolitan Water Works Act, 1896," for £220,000, and placed them under a Board (Messrs. E. Keane (Chairman), T. W. Hardwick, and J. T. Hobbs). The works transferred included Victoria Reservoir, 12in. trunk



main, service reservoir, and 31 miles of reticulation mains. The Board laid a 2lin. main from Victoria Reservoir to Mt. Eliza and sunk an artesian bore in Wellington Street in November, 1897. In 1898 a Select Committee recommended that the Board discontinue its control and the members resigned. A new Board was appointed comprising Messrs. W. Traylen (Chairman), Gray, and Rennick. This Board increased the price of water from 1s. 6d. to 2s. per 1,000 gallons. As population increased it was found necessary to extend the reticulation to Subiaco, Leederville, and North Perth, and in 1899 the Leederville Council transferred to the Board an artesian bore at Leederville recreation grounds, sunk by the Government in 1898. In 1899 the Subiaco Council also transferred a bore, sunk by the Government in 1898. In 1901 a further bore was sunk at the Causeway and an additional service reservoir provided at Mt. Eliza (capacity 2,413,000 gallons). In October, 1904, the Traylen Board was abolished by Act of Parliament and was superseded by the Minister for Works (Hon. W. D. Johnson, M.L.A.). In April, 1909, owing to the Government having no authority to construct sewerage works, a Board was proclaimed under "The Metropolitan Water and Sewerage Act, 1904," and Messrs. J. Thompson, Engineer-in-Chief (Chairman), W. T. Loton, and M. F. Cavanagh were appointed members. Towards the latter end of the year a Bill was introduced for a nominee and elective Board, but Ministerial control was substituted, and in July, 1910, the Metropolitan Water Supply, Sewerage, and Drainage Act was proclaimed and the Perth, Fremantle, and Claremont supplies were thereby brought under one administration.

In Fremantle, the first reticulation work was a pipe line laid in 1887, to convey water from wells at the Fremantle Gaol to supply shipping and a small section of the town, the water being pumped by prison labour.

On December 16, 1899, the Government assumed control of the supply of Fremantle, North Fremantle, and East Fremantle under the Act, and the works remained under the Government till merged into "The Metropolitan Water Supply" under the Act of 1909. The supply was drawn from wells with extensive drives in the limestone and two artesian bores sunk in 1902 at the Gaol, and pumped by Worthington Steam pumps to a service reservoir (800,000 gallons) at Swanbourne Street and thence reticulated throughout the district.



Claremont's original supply was from a well at Osborne, controlled by Mr. W. D. Moore and later by Mr. J. Grave. By a private Act (1899) the scheme was extended to Cottesloe, Peppermint Grove, and Buckland Hill. The works included a well at Osborne, with pumping station and elevated tanks, and a small reticulation scheme in the older portions of the suburb.

On 25th November, 1903, the Government purchased the existing works and provided a new source of supply from artesian bores (still in operation) and extended the reticulation throughout Claremont, Cottesloe, and Cottesloe Beach.

At Guildford and Midland Junction, residents relied on wells and tanks until a supply was made available in 1906 from Mundaring Weir. The Goldfields Water Supply Administration controlled the supply till 1913, when it was transferred to the Metropolitan Water Supply Department.

At the beginning of 1914 the Metropolitan Area comprised four districts—Perth, Fremantle, Claremont, and Guildford, and a new district was constituted for Armadale, but, owing to the linking up of supplies and in order to apply uniformity of administration, including rating and other charges, and provide for sewerage, stormwater drains, etc., the districts were amalgamated and the area is now divided into the Metropolitan Water and Sewerage District and Armadale Water District, and five Stormwater Districts.

Perth's first Water Supply Offices were at the corner of Howard Street and St. George's Terrace, but after the works were purchased by the Government (1896) and placed under a Board, new offices were built in Wellington Street and occupied until 1912, when the offices were transferred to James Street.







SPRING AND FOUNTAIN WELL, MOUNT'S BAY ROAD, NEAR "NARROWS."  
*Fountain installed by Governor Kennedy in 1860.*  
*This Spring and one on present Technical School site were Perth's first Public Water Supply.*



# Opening of Perth Water Works at Victoria Reservoir in September, 1891.

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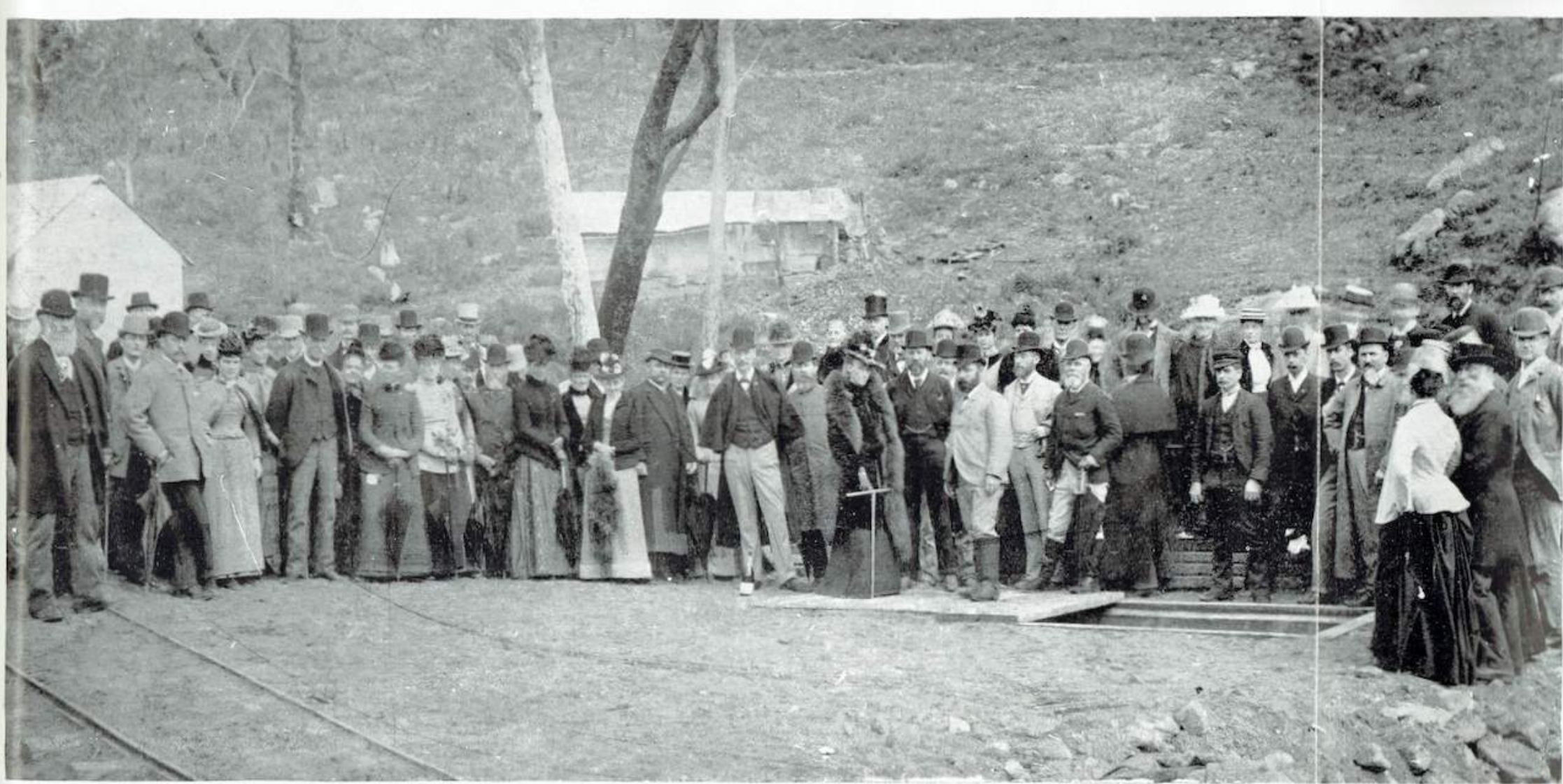
Works were purchased by Government from Messrs. McNeil, Reid, McLean, and Whittingham. Reservoir and trunk main to Mount Eliza commenced February, 1890. Water first supplied to Perth October, 1891.

Following were present at Opening, most of whom are shown in accompanying photograph :—

Sir Geo. Shenton, Father Bourke, Dr. Hope, Capt. G. Phillips, Messrs. E. K. Courthope, Silas Pearce, Wm. Patterson, H. J. Saunders, F. C. Crowder, J. M. Drummond, M. F. Canning, Jas. Cowan, J. B. Roe, W. E. Marmion, E. H. Dean Smith, W. J. George, H. D. Holmes, H. G. Turner, S. R. Hamersley, M. C. Davies, Neil McNeil, W. Burton, R. Sholl, J. W. Hackett, E. Keane, H. W. Venn, Jas. Morrison, W. Baum, J. W. Wright, Alex. Forrest, Clayton Mason, Geo. Leake, Geo. Randell, E. H. Brooking, W. Cooper, W. Pilcher, W. J. Thomas, Frank Stone, Mesdames Oct. Burt, A. Forrest, J. B. Roe, F. Stone, Marmion, Bolton, George, Keane, H. G. Turner, E. Darlot, A. Burt, M. C. Fraser, Brooking, and Misses Burges, Deb. Morrison, Ella Hooley.











ORIGINAL OFFICES AND SALARIED STAFF OF FIRST METROPOLITAN (PERTH) WATERWORKS BOARD.  
(Offices were in St. George's Terrace, on land now occupied by Perpetual Trustees' Buildings. Board appointed in 1896, consisting of Messrs. Edw'd. Keane (Chairman), T. W. Hardwick, and J. T. Hobbs, Secretary, Mr. W. H. Jones.)





PRESENT OFFICES AND SALARIED STAFF OF DEPARTMENT, IN JAMES STREET.



# Existing Water Supply System.

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The supply is derived from the Darling Ranges and from artesian bores.

Up to 1896 the only source was the Victoria Reservoir (catchment 10,000 acres), which sufficed for Perth's population (32,000), but increased demand necessitated sinking artesian bores at Wellington Street (1897), and Leederville and Subiaco (1898).

In 1902 the bywash of Victoria Reservoir was raised one foot, increasing capacity from 200 to 212 million gallons. This reservoir consists of a curved concrete wall 750 feet long and 104 feet high from bottom of foundations to crest of weir, and has a depth of water of 53 feet.

The next step in procuring augmented "Hills" supply was the construction of a pipe head dam on Bickley Brook, by which supplies (varying) up to 1,000,000 gallons daily are available.

Another source is the Mundaring Reservoir on the Helena River, about 25 miles from Perth. From this reservoir about 1,000,000 gallons per day have been obtained since 1906 by means of a 13in main from the Weir to Greenmount service reservoir.

In 1921 a small reservoir was built on Bickley Brook to store overflow from Victoria Reservoir and the Upper Bickley Pipe Head Dam and to act also as a service reservoir for Cannington District. This reservoir, like the Victoria Reservoir, has a curved wall, length 526 feet; maximum height of wall 43 feet; capacity when full  $23\frac{1}{2}$  million gallons.

From 1902 to 1921, 15 artesian bores were sunk in Perth, Fremantle, Claremont, etc., to augment supplies, the maximum available output therefrom being about 11 million gallons per day.

There are four main pumping stations, used in connection with the bores, to deliver water to service reservoirs for distribution: and a subsidiary station at Subiaco pumps direct into the reticulation.



The largest pumping station (at Loftus Street, Perth) delivers water through a 21in. rising main to the Mt. Eliza service reservoirs. The waters from bores at Redan and Regent Streets, Leederville, gravitate to suction tanks, where the Loftus Street bore water is also collected, and pumped thence to Mt. Eliza by three sets of Worthington duplex triple expansion surface condensing pumps and one standby set. The pumps are supplied with steam by one Stirling and one Babcock and Wilcox boiler, with superheaters and mechanical stokers. The combined pumps can lift about five million gallons per day 200 feet high.

Another station, at Roberts Street, Osborne Park, is equipped with an electrically driven centrifugal pump, capable of lifting  $2\frac{1}{2}$  million gallons per day into the Osborne Park service reservoirs.

Three artesian bores at Osborne Park deliver into the suction tank at this station.

The Subiaco Station has an electrically driven air compressor and pump, the compressor supplying air for an air-lift equipment in the bore.

The Claremont Station has a collecting sump, into which water flows from two bores, No. 1 bore being at the sump and No. 2 bore about half a mile distant. The plant consists of one Worthington triple expansion horizontal duplex pump (capacity 25,000 gallons per hour) and an Auxiliary (12,000 gallons). The water is pumped to service reservoirs on high land at Swanbourne.

Fremantle is the oldest station in the State and the present supply is obtained partly from wells and their extensive drives, but chiefly from two bores delivering into an underground sump and pumped into the service reservoirs by two Worthington vertical pumps and one electric.

The Metropolitan Area is now provided with service reservoirs in advantageous positions to maintain pressures over the whole area, and to ensure an adequate supply during hot weather, when the draw-off is comparatively heavy.

The first of these reservoirs was provided at Mt. Eliza by the Perth Water Works Co. in 1890, of 784,000 gallons capacity, to serve the Perth District, and was followed by one at Swanbourne Terrace, Fremantle. These were added to from time to time until there are now 19 reservoirs (total storage  $81\frac{1}{4}$  million gallons).



The Mt. Eliza group of service reservoirs (total capacity 26,950,000 gallons) is the main distributing centre for Perth Area, and is sufficiently elevated to supply Osborne Park, Claremont, and Fremantle groups.

The reservoirs at Osborne Park (total capacity 12,850,000 gallons) maintain the pressures in high portions of surrounding districts. A filtration plant is installed close to the reservoirs, through which water, pumped from bores, passes before entering service reservoirs.

The Fremantle group, at Melville Park, Richmond Hill, and Swanbourne Terrace (total capacity 12,000,000 gallons) serve Fremantle and suburbs. Richmond Hill Reservoirs are used exclusively for storing "Hills" water for shipping, Railway Department, Wool Scouring, and a small area of the town adjoining, and are fed by an 8in. pipe from the "Hills" Main at Queen's Park, via Canning Road.

Other service reservoirs are Claremont (904,000 gallons), Greenmount (1,023,000 gallons), and Buckland Hill (4,000,000 gallons).

The reticulation, which originally consisted of one trunk main from Victoria Reservoir to Mt. Eliza, 12in. diameter and about 17 miles long, together with smaller pipes totalling 48 miles, now totals slightly over 700 miles, with a range from 1½in. to 36in. diameter. Reinforced concrete pipes are now used for some of the larger supply mains, the largest being 30in., the smallest 12in.





## BORES USED FOR METROPOLITAN WATER SUPPLY.

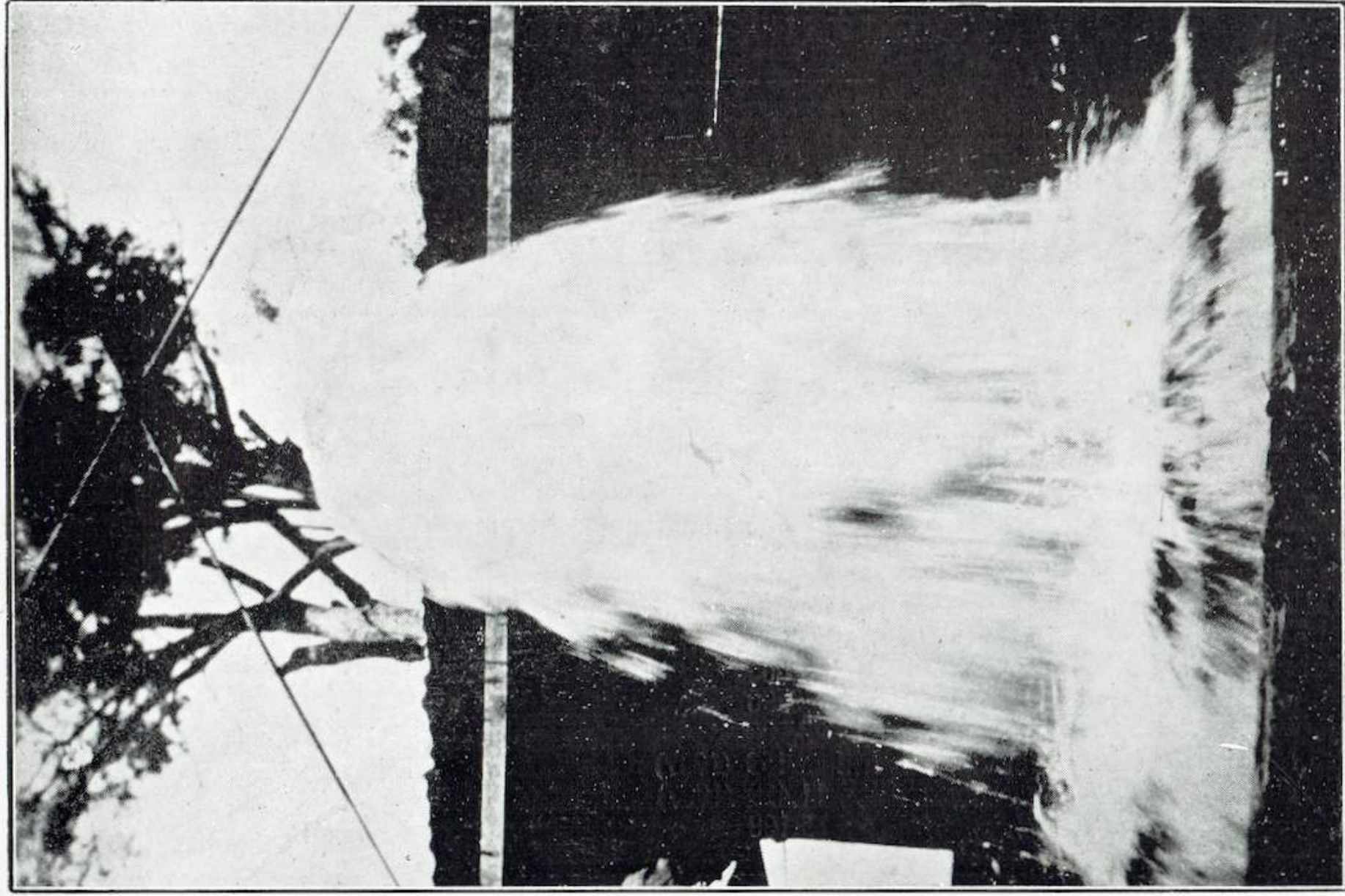
Bore.	Diameter.	Date Sunk.	Flow Gallons per day.	
			Original.	Latest Recorded
West Perth Station Yard .. .. .	5in.	September, 1897 ..	384,000	Closed
Wellington Street .. .. .	4in., 5in., and 6in.	November, 1897 ..	590,000	Closed
Subiaco .. .. .	5in. and 6in.	15th January, 1898 ..	450,000	280,000
Leederville Recreation Ground .. .. .	6in.	12th December, 1898 ..	217,000	Closed
Fremantle No. 1 .. .. .	8in.	16th January, 1902 ..	99,000	2,100,000
Fremantle No. 2 .. .. .	4in.	26th June, 1902 ..	1,070,000	
Claremont No. 1 .. .. .	5in.	9th January, 1903 ..	314,000	478,000
Causeway .. .. .	4in. to 8in.	19th November, 1903 ..	334,000	Closed
Redan Street .. .. .	6in. and 8in.	11th March, 1904 ..	720,000	779,040
West Guildford .. .. .	6in.	1st October, 1904 ..	900,000	Closed
Claremont No. 2 .. .. .	8in. and 10in.	3rd March, 1906 ..	1,000,000	868,000
Loftus Street No. 1 .. .. .	10in.	4th October, 1907 ..	1,870,000	279,360
Old Men's Home .. .. .	6in.	December, 1908 ..	1,000,000	..
Loftus Street No. 2 .. .. .	10in.	29th December, 1911 ..	4,000,000	1,588,760
Loftus Street No. 1 .. .. .	8in.	25th May, 1912 ..	1,400,000	1,185,120
Regent Street .. .. .	10in.	27th November, 1917..	1,080,000	745,920
Roberts Street .. .. .	10in.	28th October, 1920 ..	1,250,000	1,200,000
Hector Street .. .. .	12in.	15th April, 1921 ..	1,800,000	1,800,000
King Edward Street .. .. .	10in.	10th September, 1921 ..	1,480,000	1,480,000

# Water Supply Statistics.

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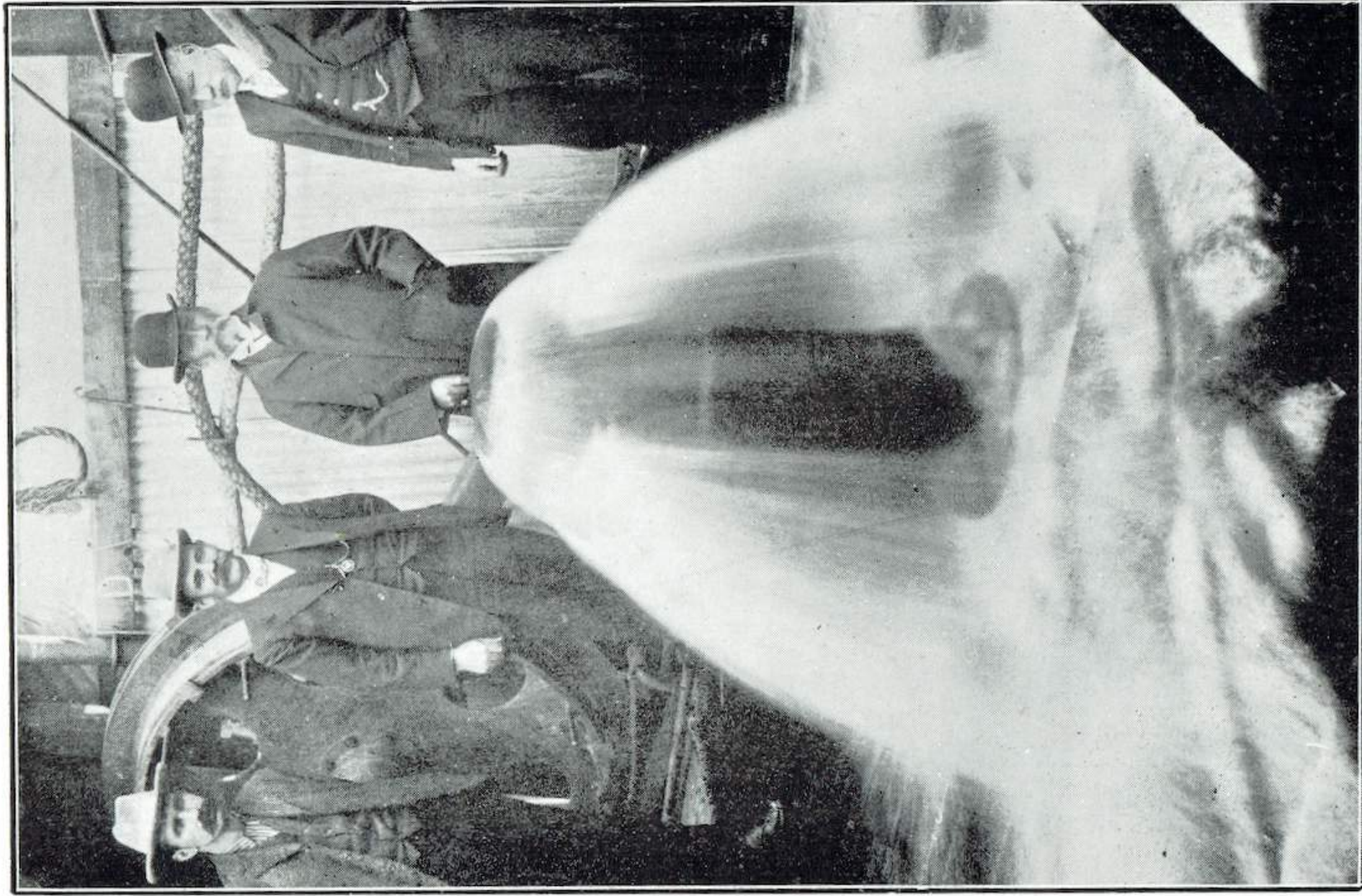
Catchment Areas Reserved .....	Approximately 700 square miles				
Capacity of Main Reservoirs, gallons—Victoria .....	211,400,000				
Lower Bickley .....	23,350,000				
	<u>1896.</u>			<u>1925.</u>	
Area served .....	4 sq. miles			100 sq. miles	
No. Bores .....	Nil			13	
No. of Service Reservoirs .....	1			19	
Capacity of Service Reservoirs .....	784,000 gallons			81,157,000 gallons	
No. Pumping Stations .....	Steam .....	Nil		Steam .... 2	Boosters—Steam and 1
	Electric ....	Nil		Electric.... 2	Electric
				Electric & 1	Electric .... 2
				Steam	<u>3</u>
				5	
Volume of Water pumped ....	Nil			1,812,011,000 gallons	
Annual Consumption .....	168,354,000 gallons			2,893,700,000	„
Average Daily Consumption .....	461,244	„		7,928,000	„
Maximum Day's Consumption .....	700,000	„		15,600,000	„
Consumption per head per day .....	22.90	„		40.5	„
Population served .....	22,500			178,000	
Length Mains laid (lin. to 36in.) .....	Miles 153 (1907)			Miles 713	
No. Services .....	11,429 (1907)			40,741	
No. Metered Services .....	5,100			23,416	





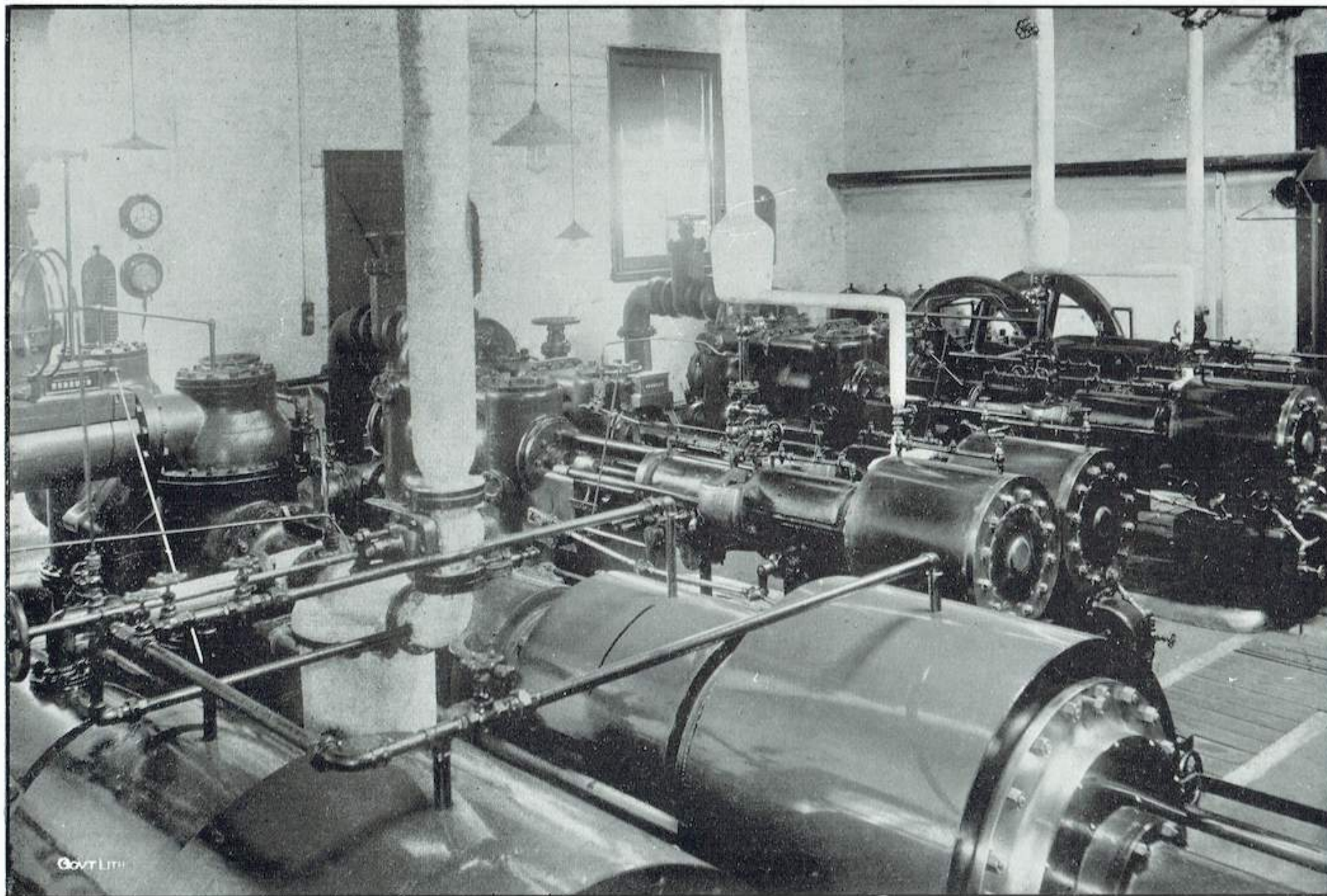
ARTESIAN BORE AT OSBORNE PARK.





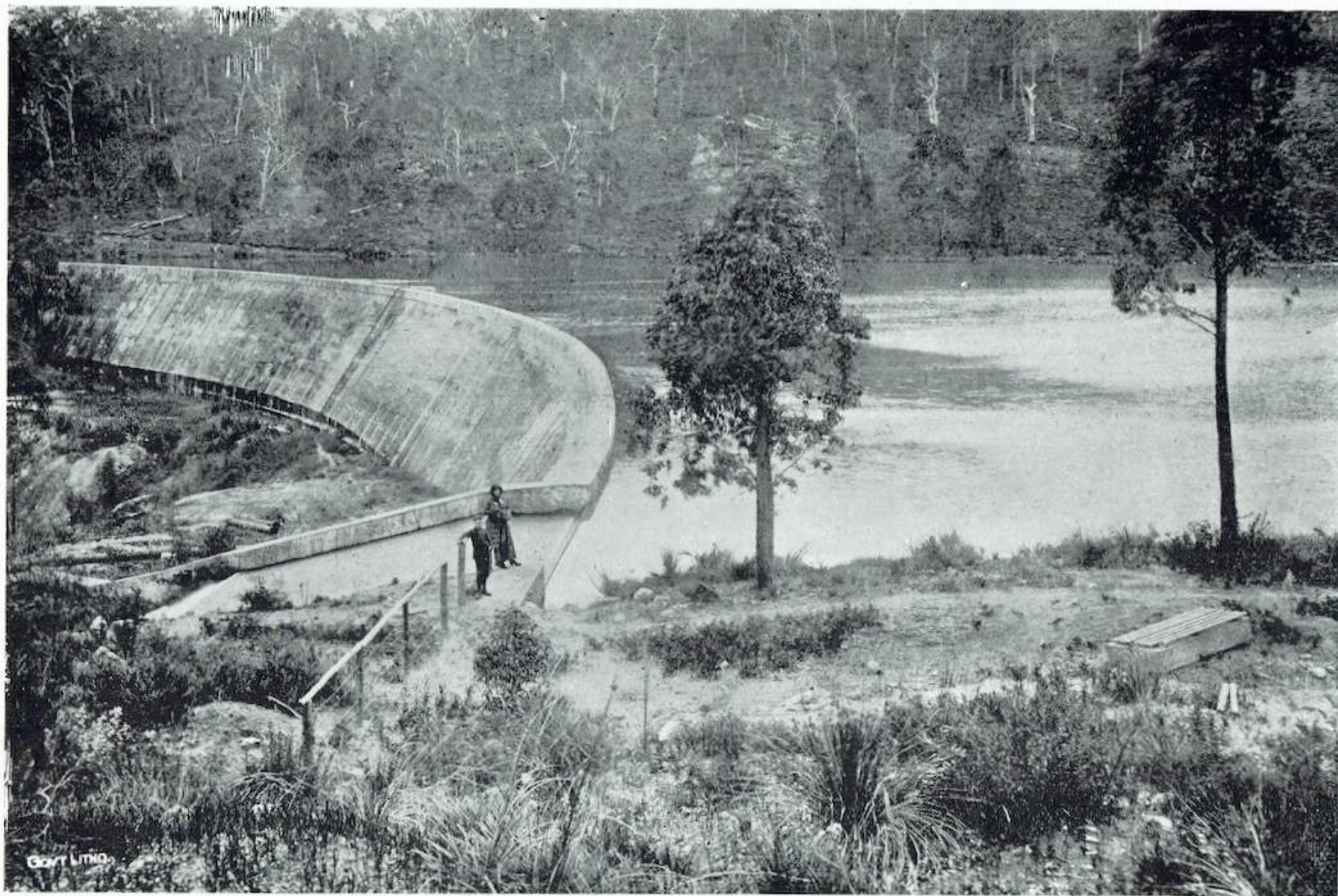
ARTESIAN BORE AT LOFTUS STREET.





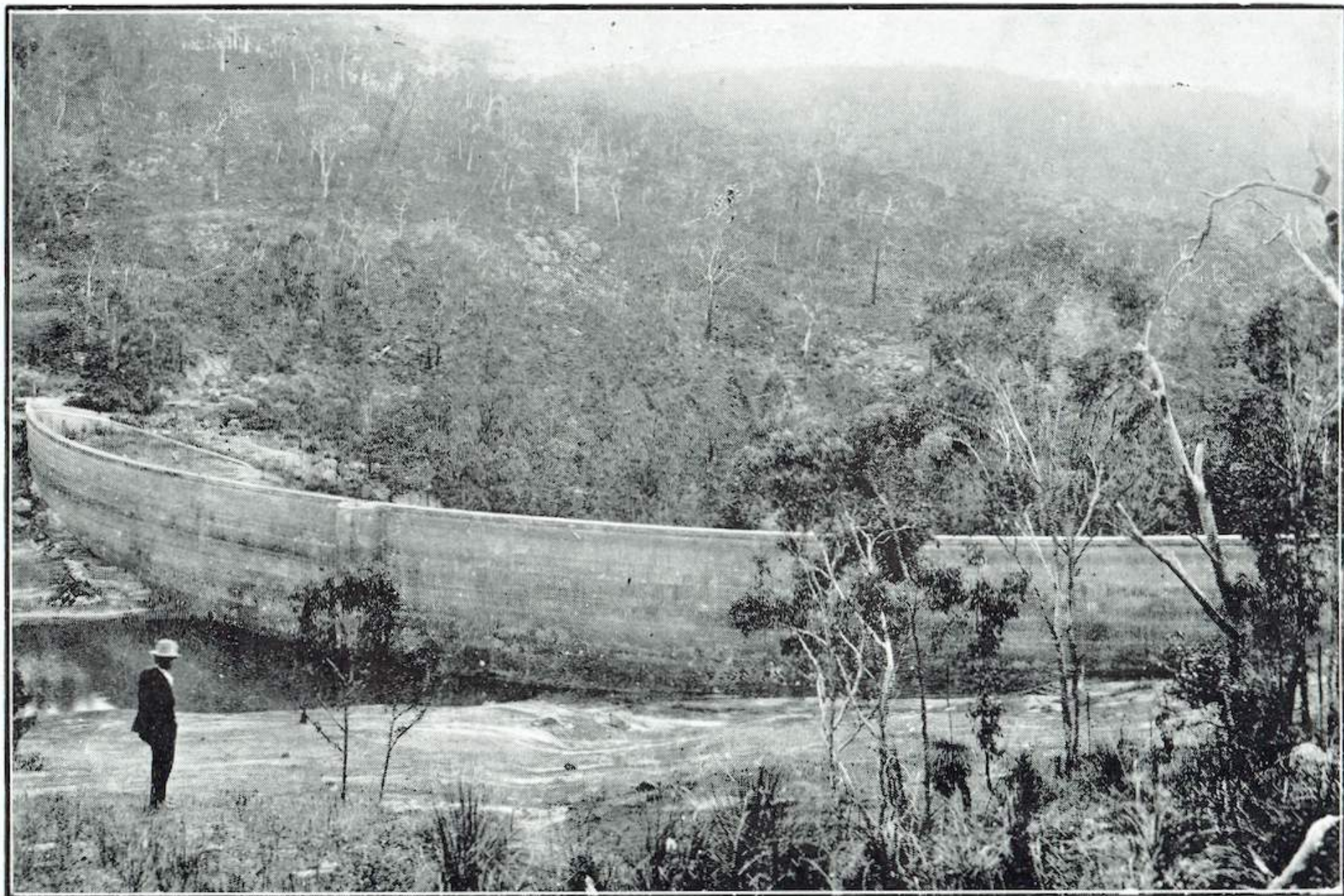
MACHINERY AT LOFTUS STREET STATION.  
*For pumping Bore Water to Mt. Eliza Reservoirs.*





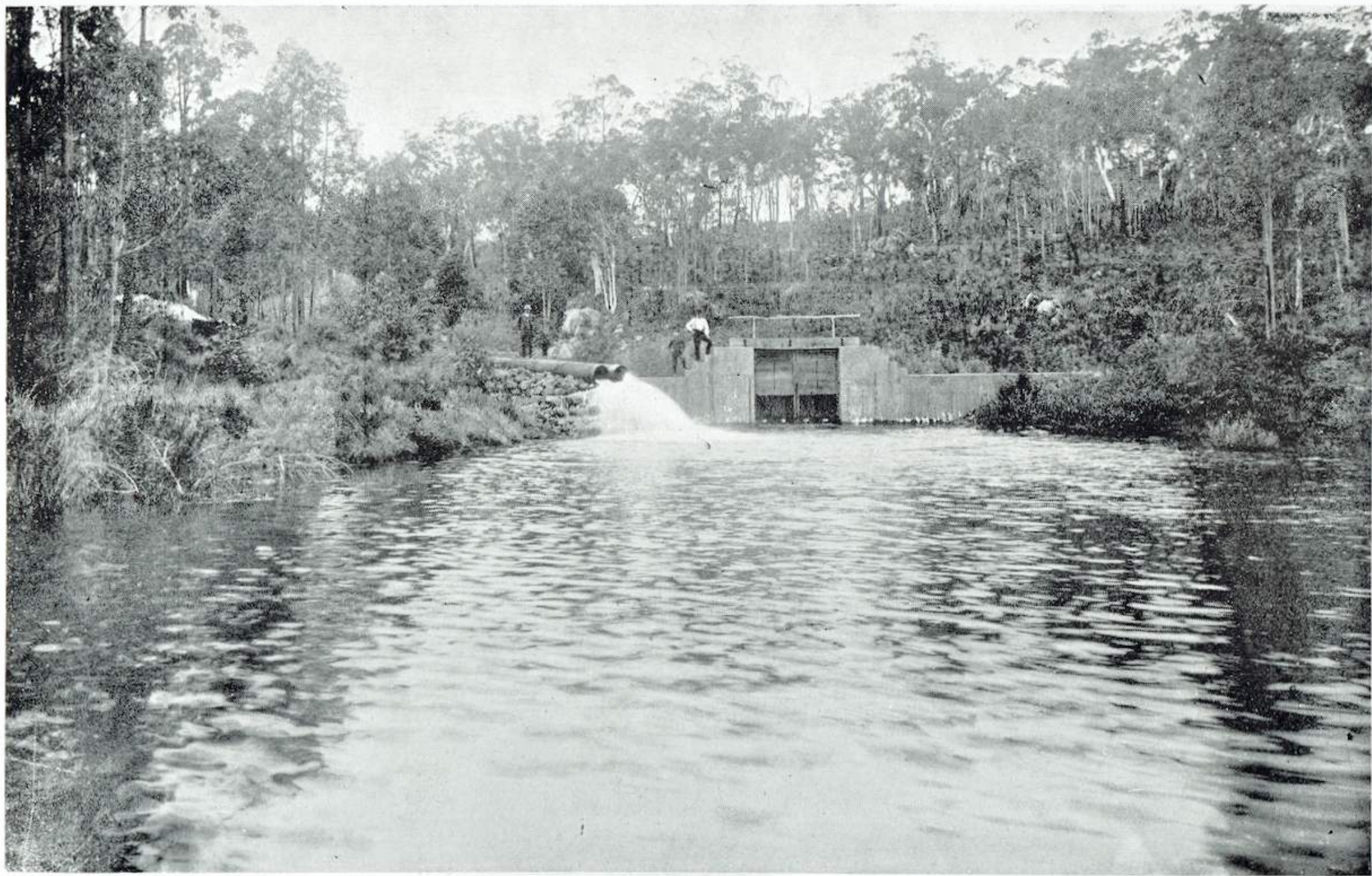
VICTORIA RESERVOIR.  
*Capacity 211,400,000 gallons ; Completed October, 1891*





VICTORIA RESERVOIR.  
*End of Summer.*





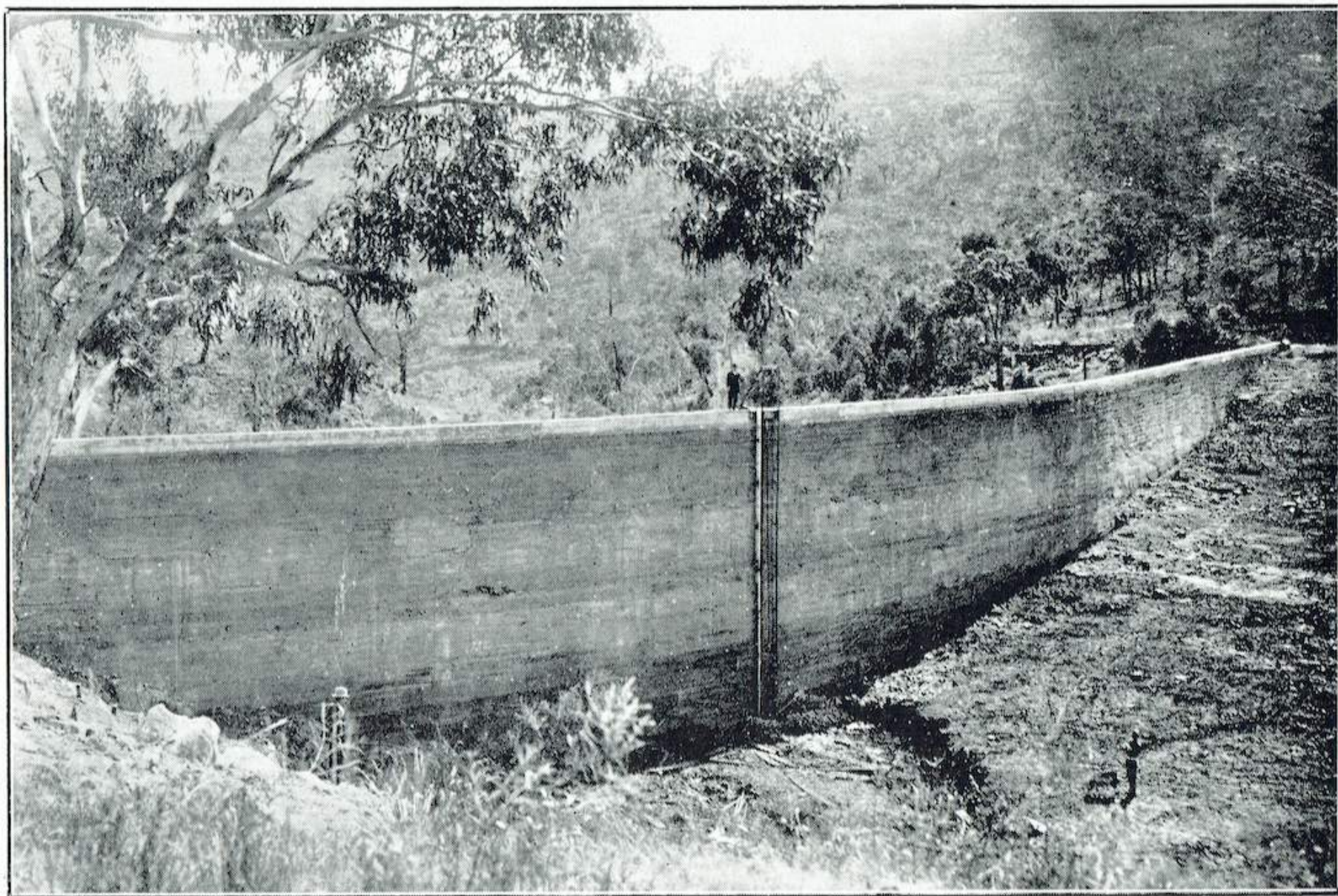
INTAKE TO VICTORIA RESERVOIR.





LOWER BICKLEY BROOK RESERVOIR.  
*Capacity 23,350,000 gallons ; Completed September, 1921.*



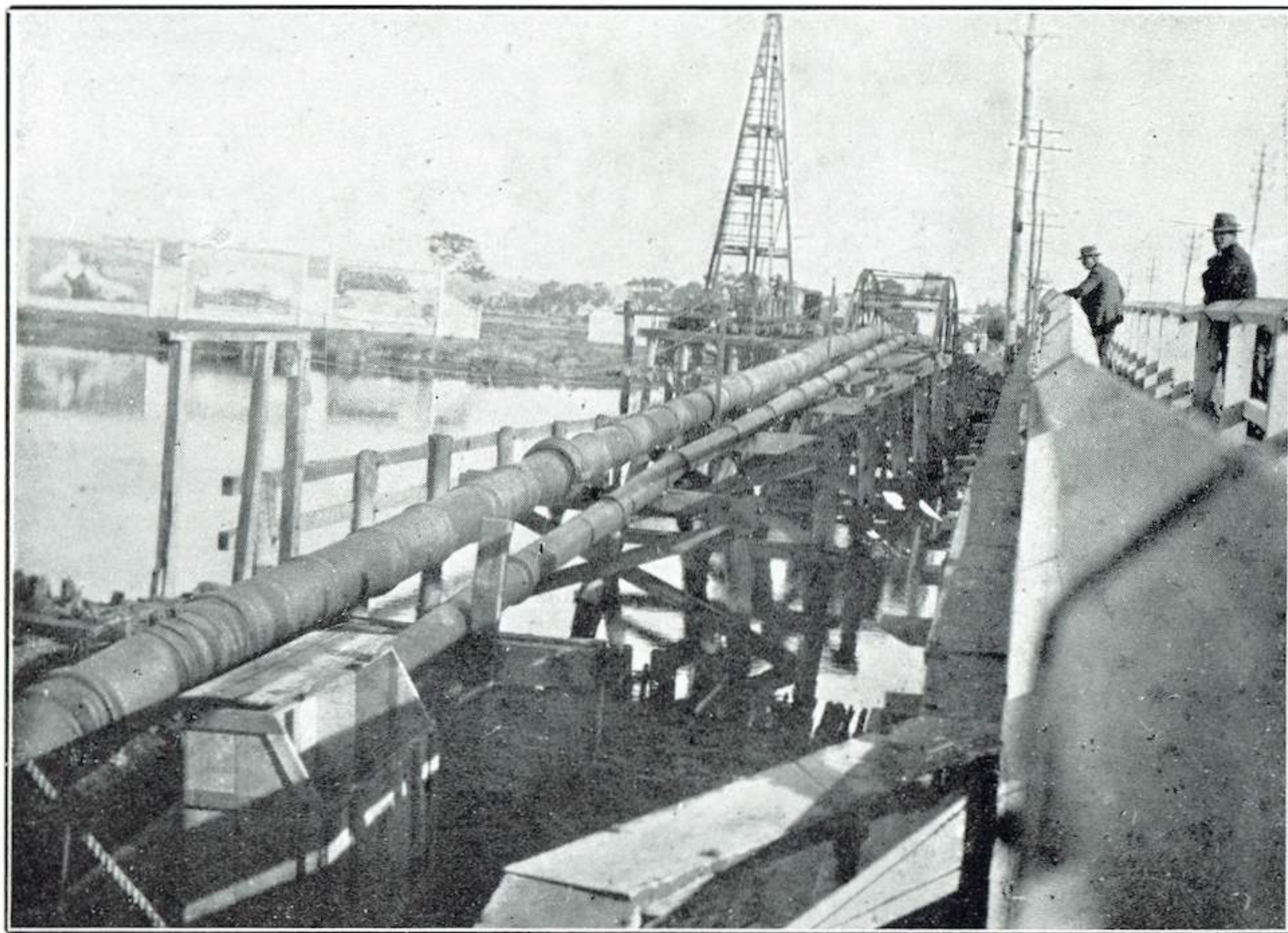


LOWER BICKLEY BROOK RESERVOIR.  
*End of Summer.*



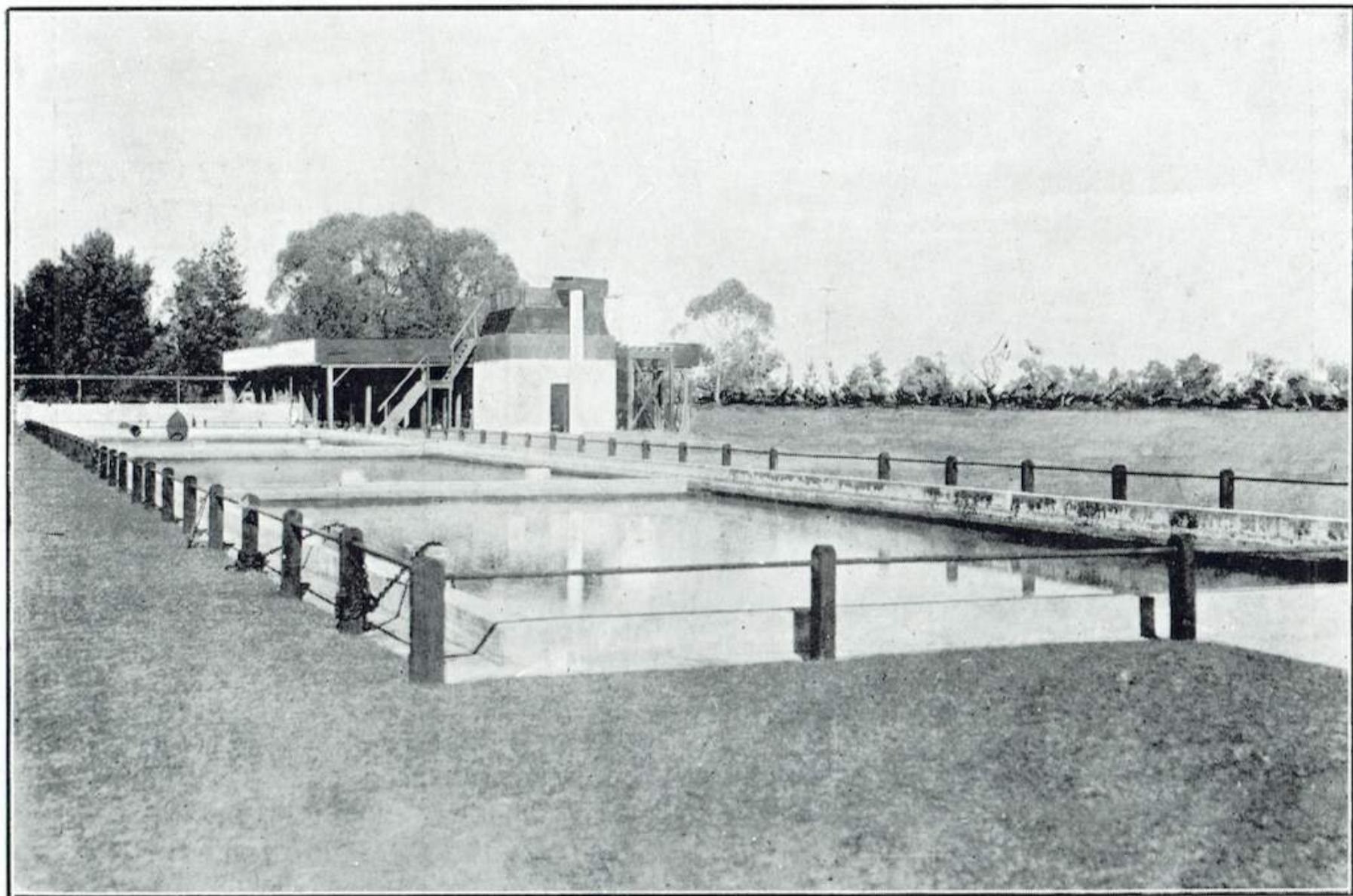


BICKLEY BROOK PIPE HEAD DAM.  
*Completed November, 1911.*

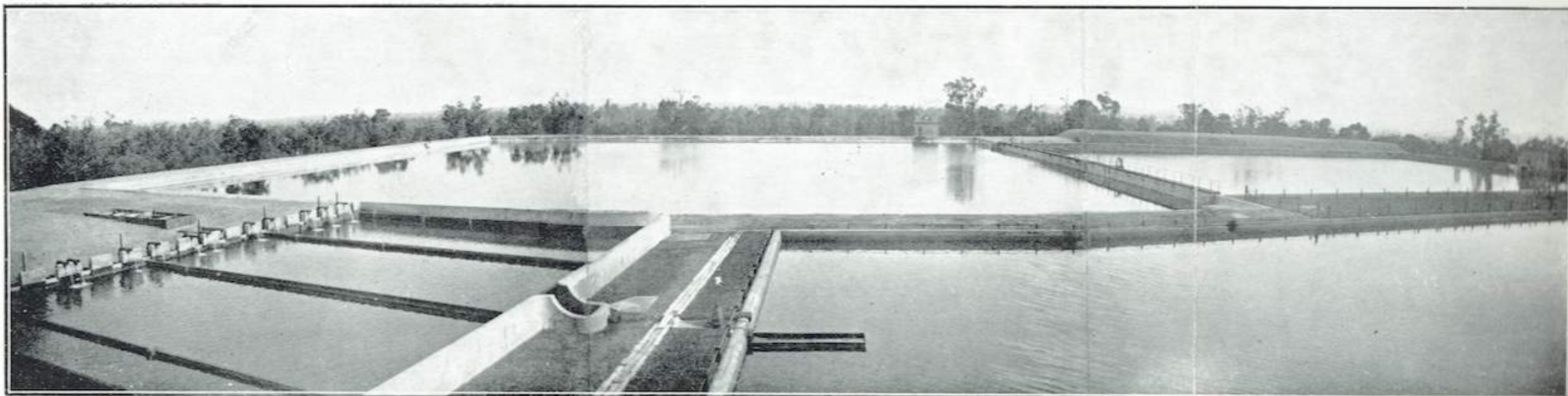


21IN. AND 12IN. MAINS FROM VICTORIA RESERVOIR.  
*Crossing over River at Causeway.*





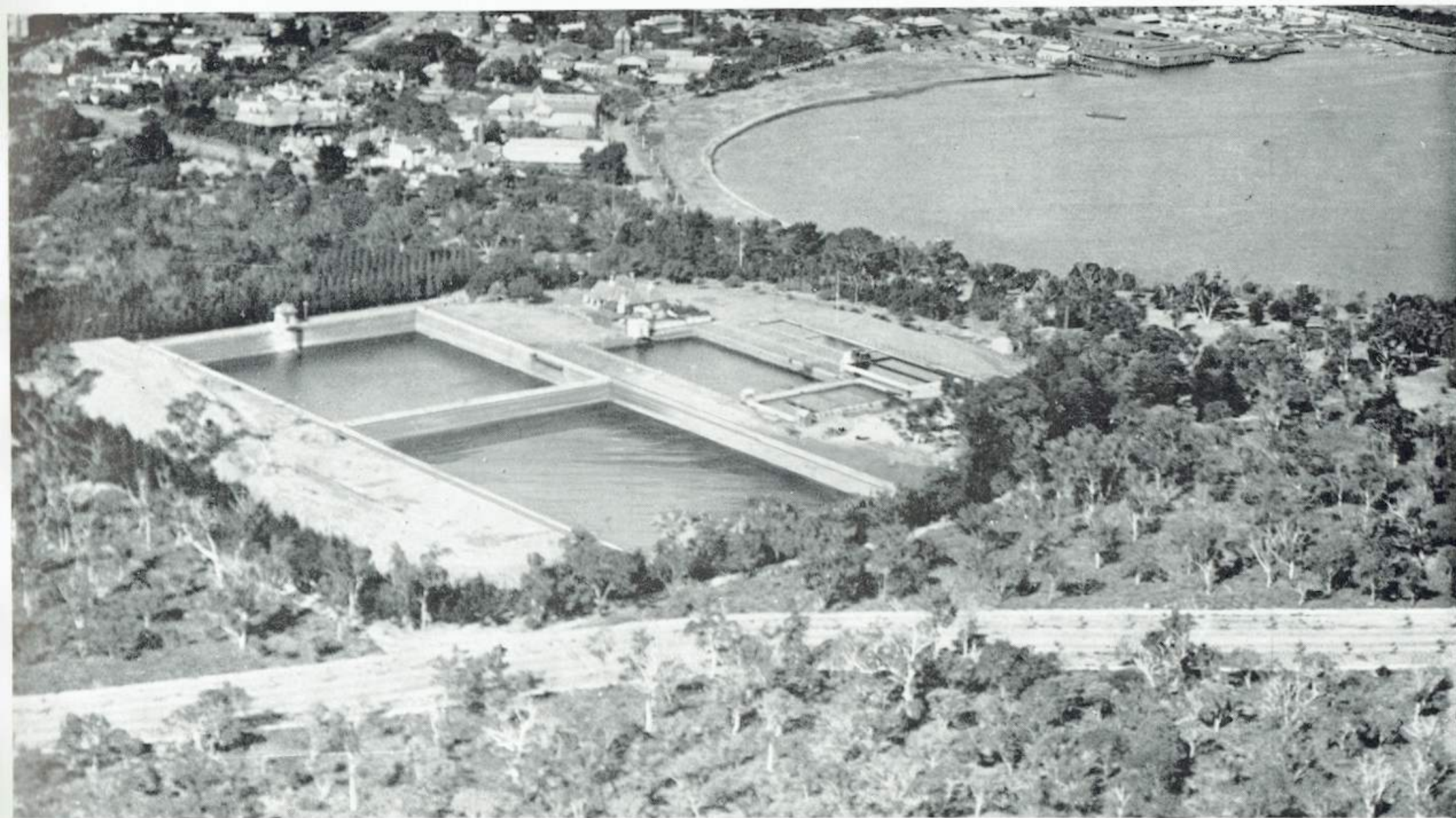
FIRST SERVICE RESERVOIR CONSTRUCTED (MT. ELIZA).  
(Capacity 784,000 gallons. Completed by Water Co. 1890.)



PANORAMIC VIEW OF RESERVOIRS, MT. ELIZA.

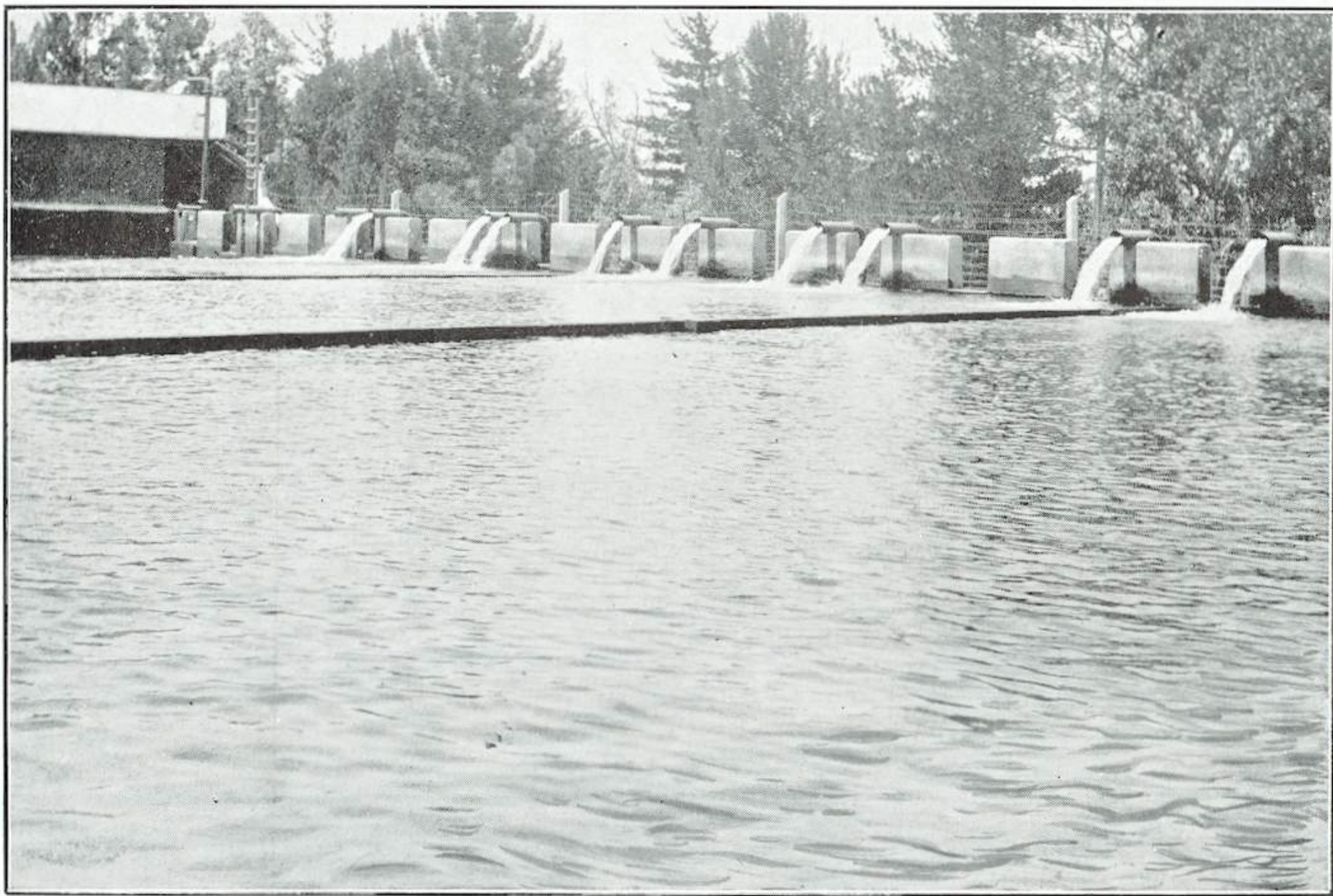
No. 1	Reservoir,	capacity	784,000	gallons,	completed	1890.
" 2	"	"	2,413,000	"	"	1901.
" 3	"	"	10,153,000	"	"	1913.
" 4	"	"	13,600,000	"	"	1924.





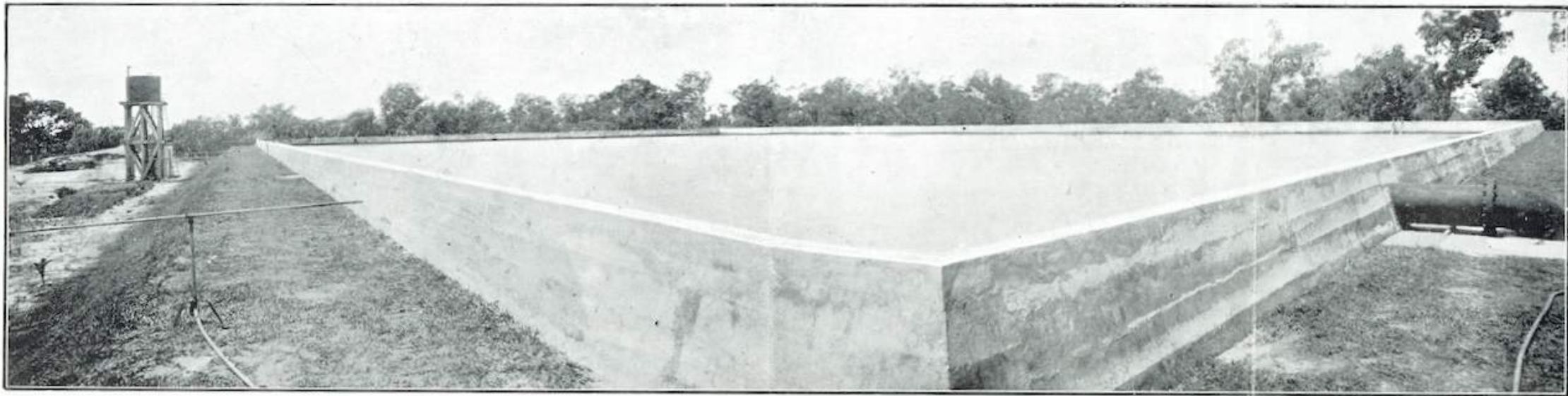
AERIAL VIEW OF RESERVOIRS, MT. ELIZA.  
(Total Capacity 26,950,000 gallons.)





COOLING BASINS, MT. ELIZA.



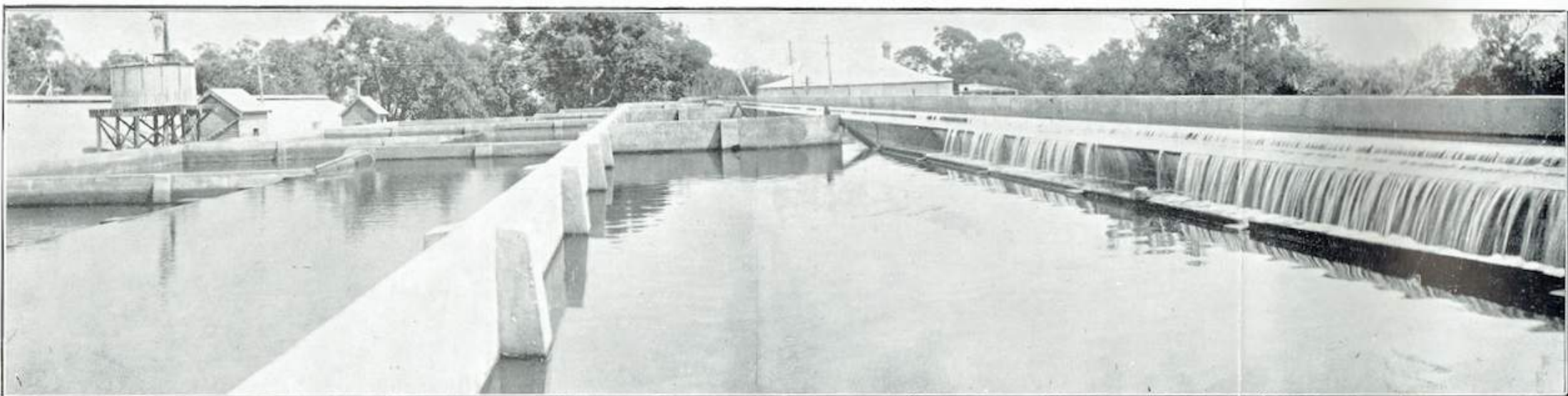


RESERVOIR, MELVILLE PARK.  
(Capacity 9,664,000 gallons. Completed December, 1923.)



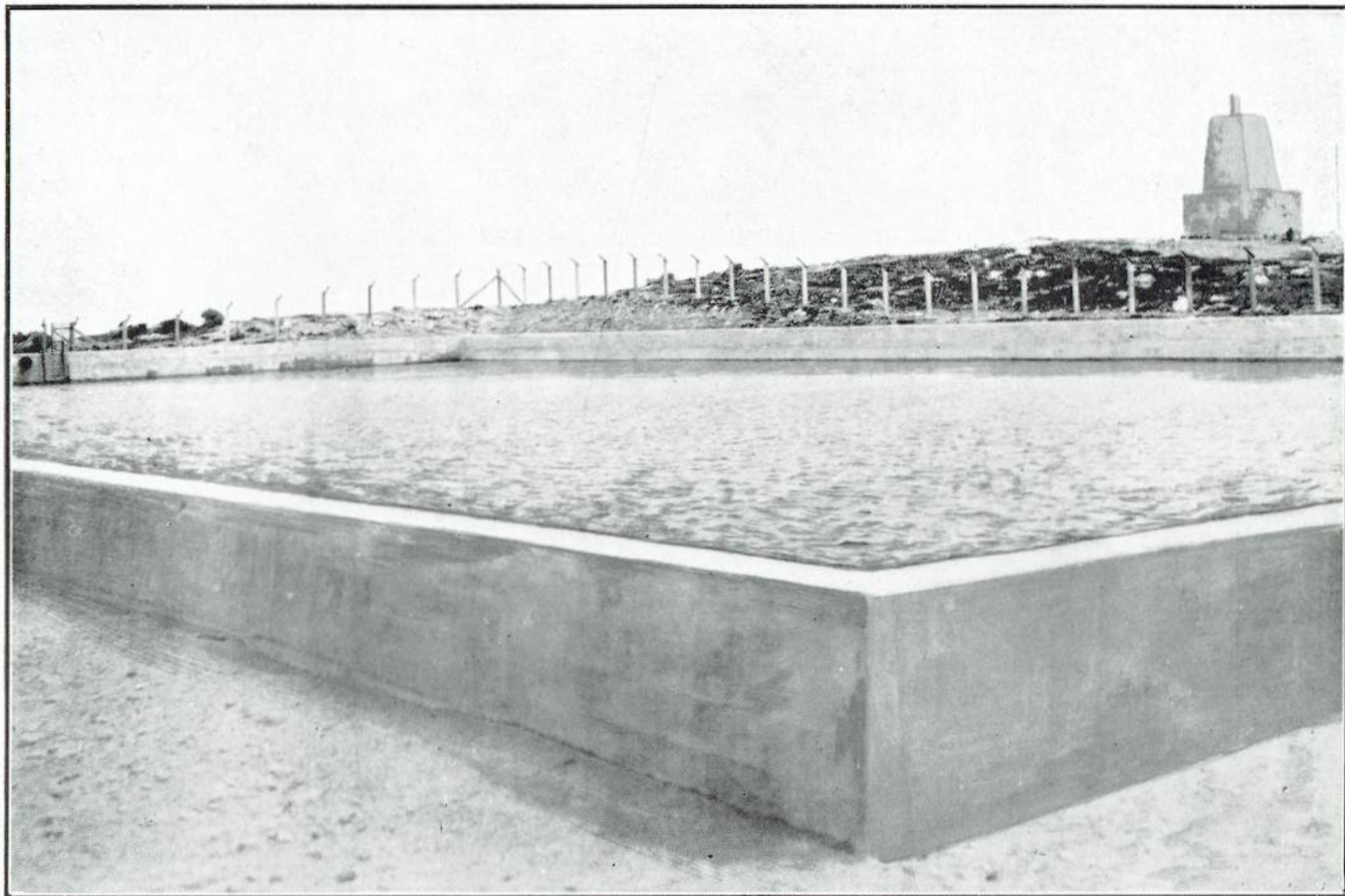


RESERVOIR NO. 3, OSBORNE PARK.  
(Capacity 9,336,000 gallons. Completed December, 1923.)

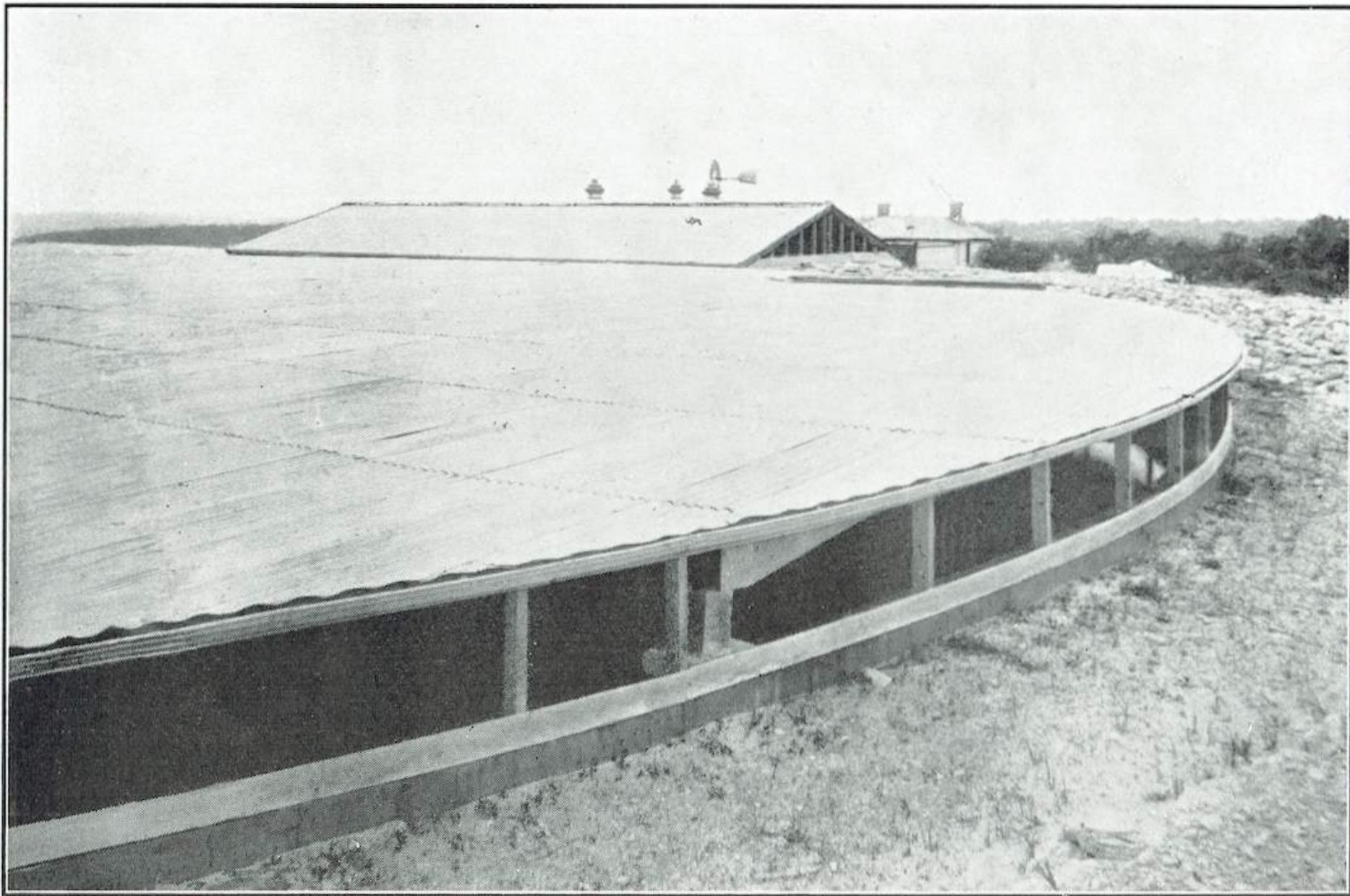


WATER FILTRATION PLANT, OSBORNE PARK.



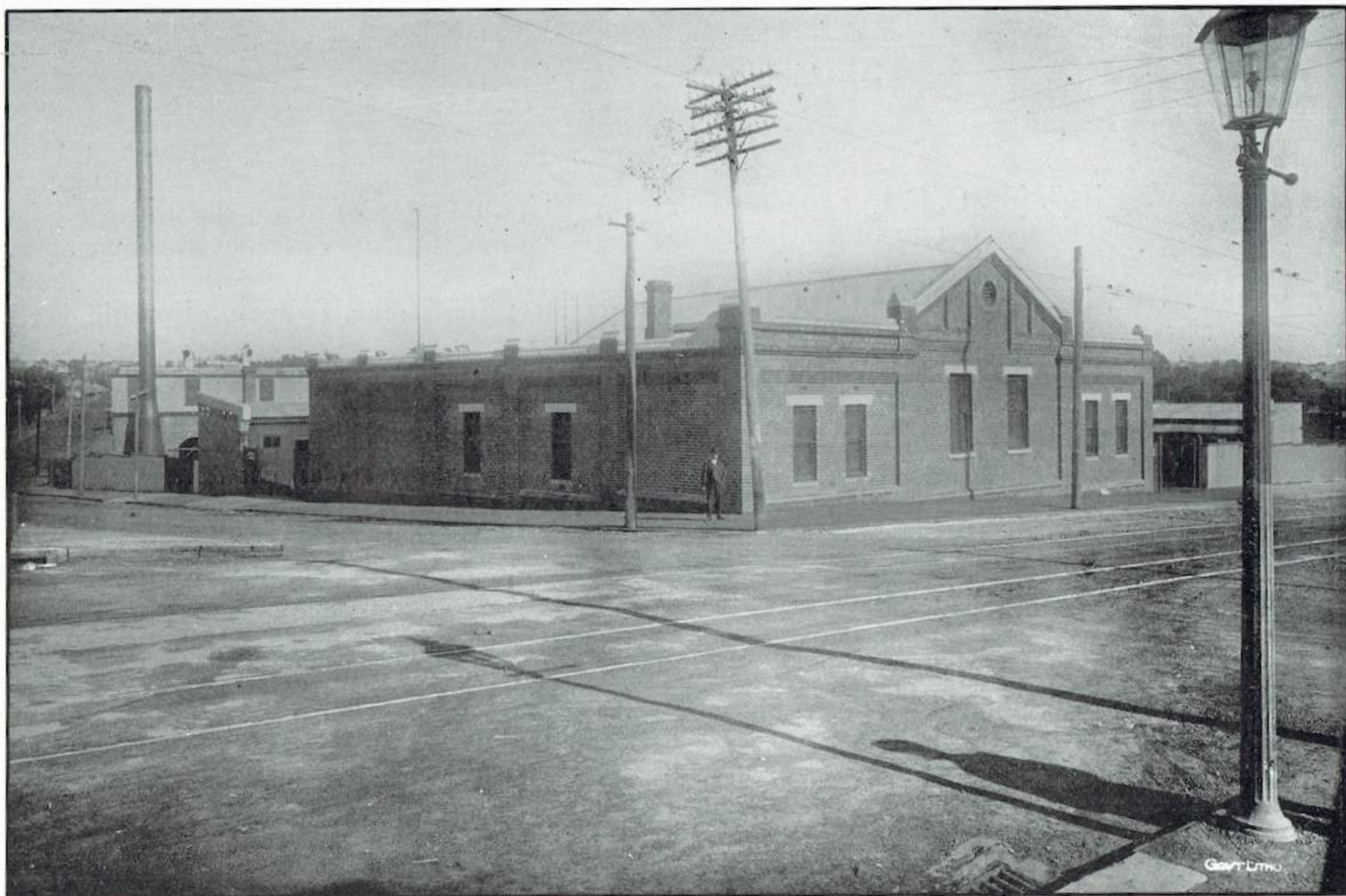


RESERVOIR, BUCKLAND HILL.  
(Capacity 4,000,000 gallons. Completed July, 1925.)



RESERVOIR, RICHMOND (FREMANTLE).  
(Capacity 1,060,000 gallons. Completed May, 1921.)





STORE AND PUMPING STATION, LOFTUS STREET, LEEDERVILLE.

## “Hills” Water Scheme.

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In February, 1903, Mr. C. S. R. Palmer, Engineer-in-Chief, reported on the comparative merits and cost of gravitation and pumping schemes for the Metropolitan Area, and he recommended obtaining supplies from artesian sources.

In July, 1903, Mr. J. Davis, M.Inst.C.E., Under Secretary for Works, Sydney, also submitted a report for a supply, which dealt with:—

- (1) Supplementing gravitation scheme from Munday's Brook.
- (2) Constructing gravitation scheme from Canning River.
- (3) Extending supply from artesian bores; and he recommended—
  - (a) Sinking further artesian bores to provide additional 4,000,000 gallons per day.
  - (b) Providing additional 5,000,000 gallons per day from a reservoir on Canning River; and
  - (c) Obtaining Legislative authority for regulating and controlling existing artesian bores in Metropolitan Area.

In 1907 a Board was appointed to report on a scheme to supply from the Hills and, after exhaustively considering various proposals, including schemes for utilising the Helena River, recommended a reservoir on the Upper Canning River.

In July, 1920, Mr. E. G. Ritchie, Engineer for Metropolitan Water Supply, Melbourne, reported on the best means for augmenting the supply, having regard to:—

- (a) Artesian bores;
- (b) Increased supply from Mundaring Reservoir;
- (c) Canning River at Nicholson Road;
- (d) Canning River Dam;



and he recommended that no expenditure be at present incurred on a new supply from Mundaring ; that Nicholson Road Scheme be not proceeded with ; that no more money be expended on bores, and that gravitation supply be provided from the Canning River and tributaries. He also recommended arranging for surveys, etc., to decide a works programme, so as to ease the financial burden by spreading expenditure over years. These investigations resulted in the Government deciding to construct a dam at Churchman's Brook, immediately, with necessary pipe lines to Perth from this Dam and Pipe Head Dams to be constructed on the Canning River and Wungong Brook, and on completion of these works to provide a storage reservoir on the Wungong Brook and thereafter one on the Canning River.

The construction of an earthen dam on Churchman's Brook was commenced early last year. It is anticipated that sufficient progress will be made to enable water to be stored during the winter of 1927 for use during the following summer. In the meantime full use will be made of the daily flow of the stream. Churchman's dam will have a height of 75 feet above the original bed of the brook at the dam site, and will store about 512 million gallons.

The pipe lines to carry the water to Mt. Eliza are :—

- (a) 16in. diameter, Churchman's Dam to junction with Canning River ; length, 1 mile 52 chains.
- (b) 30in. diameter from junction of Churchman's Brook with Canning River to Kelmscott ; length, 2 miles 73 chains.
- (c) 36in. diameter, Kelmscott to Perth ; length, 16 miles 75 chains.
- (d) 30in. diameter, from Pipe Head Dam on the Canning River to junction Churchman's Brook and Canning River ; length, 2 miles 10 chains.
- (e) 30in. diameter, from Pipe Head Dam on Wungong Brook to Kelmscott ; length, 8½ miles.

The pipes for the lines were supplied by Messrs. Mephan Ferguson, Ltd., and are steel, of the locking bar type.

The 16in. pipes were made in Adelaide, and the 30in. and 36in. at Maylands, the work having been commenced in August, 1924, and completed August, 1925. The plates and bars, from which the pipes were made, were imported from England.

The construction of the pipe lines was commenced in August, 1924, with the laying of the 16in. line from Churchman's Dam to Canning River. Thereafter, the 30in. main was laid down the Canning River from Churchman's Brook to Kelmscott; then the 36in. pipe from Kelmscott to Perth; and finally the 30in. lines from the pipe head dams on the Canning River and Wungong Brook to junction with the pipes previously laid.

The proposals for conserving water on the Wungong Brook and Canning River provide for large concrete dams in both cases. The Wungong Dam is estimated to cost £429,238 and to impound 6,800 million gallons; and the Canning Dam to cost £1,156,375, and impound 16,890 million gallons.

During the past year shafts were sunk on the Wungong Dam site to ascertain the nature of the foundation; and plans are now being prepared.

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### ESTIMATED FUTURE REQUIREMENTS.

When the Government assumed control of the Supplies in 1910 the quantity drawn from the various sources totalled an average of 3 million gallons per day throughout the year. By 1914 the consumption had increased to  $4\frac{1}{2}$  million gallons per day; in 1919 to 6 million gallons per day, and in 1924 to  $8\frac{1}{4}$  million gallons per day. The increase in the average consumption, 1919 to 1924, has been about seven per cent. per annum. At the same rate of increase the quantities of water that must be made available for 1926 is  $9\frac{1}{4}$  million gallons per day and in 1932 14 million gallons per day.

The capacity of the existing sources with good rainfalls is  $8\frac{1}{4}$  million gallons per day average for the year with a maximum of about 13 million gallons per day, to meet the heavy requirements during January, which has increased from 9 million gallons per day (January, 1919), to 13 million gallons per day (January, 1925), that is,  $7\frac{1}{2}$  per cent. per annum.

On this basis the water required for January, 1926, is 14 million gallons per day, and for January, 1932, 22 million gallons per day.



The estimated quantities available for midsummer from the various existing and proposed sources are :—

	Bores.	Million gallons per day.
Leederville	....	3.8
Osborne Park	....	2.0
Subiaco	....	0.3
Claremont	....	0.9
Fremantle	....	3.0
Mundaring	....	0.9
Victoria Reservoir	....	1.7
Upper Bickley	....	0.3
Lower Bickley	....	0.3
Churchman's Pipe Head Dam	....	0.6
Canning River Pipe Head Dam	....	1.0
Wungong River Pipe Head Dam	....	1.0
Total	....	15.8
Additional Supply when Churchman's Dam completed		4.4
		<hr/> 20.2 <hr/>

Say, 20 million gallons.

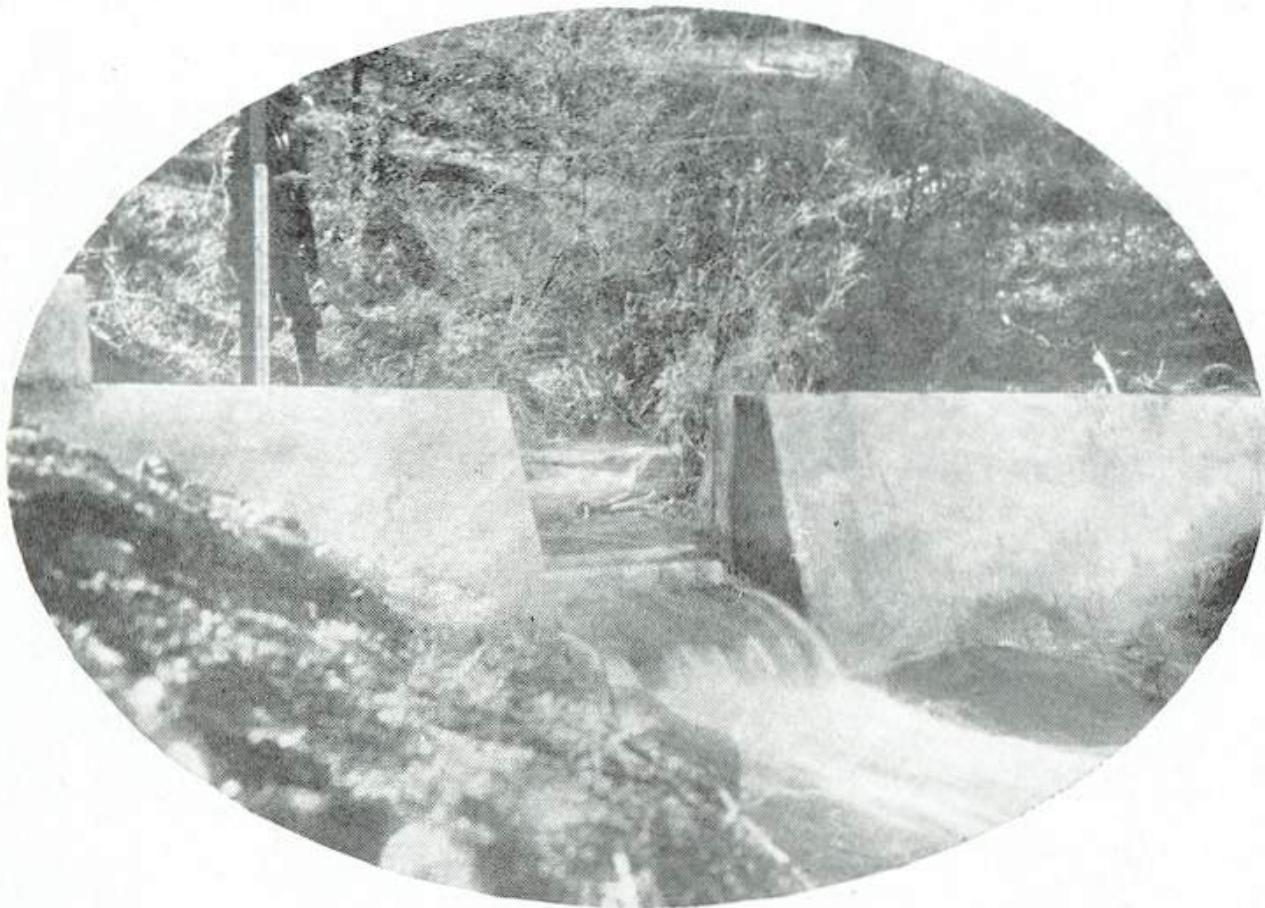
When the Wungong Dam is completed the estimated maximum summer supply therefrom will be 12 million gallons per day, and from the Canning Dam 24 million gallons per day.

It is anticipated that the pipe head dams on the Canning River and Wungong Brook will satisfy requirements in winter and early summer pending construction of Wungong and Canning Dams, and that Victoria and Churchman's Reservoirs will meet midsummer draw until the Wungong Dam is finished, when the latter will safeguard the supply till the Canning Dam is completed.

Pending completion of Wungong Dam it will be necessary to retain some of the bores to meet midsummer consumption and possibly thereafter, depending on the quantity conserved in storage reservoirs and the increase in demand.







GAUGING WEIR, UPPER CANNING.

*(Similar Weirs are located on "Hills" Streams to test flows for data of water supply resources.)*



CHURCHMAN BROOK DAM SITE, CLEARED IN READINESS FOR CONSTRUCTION WORK.





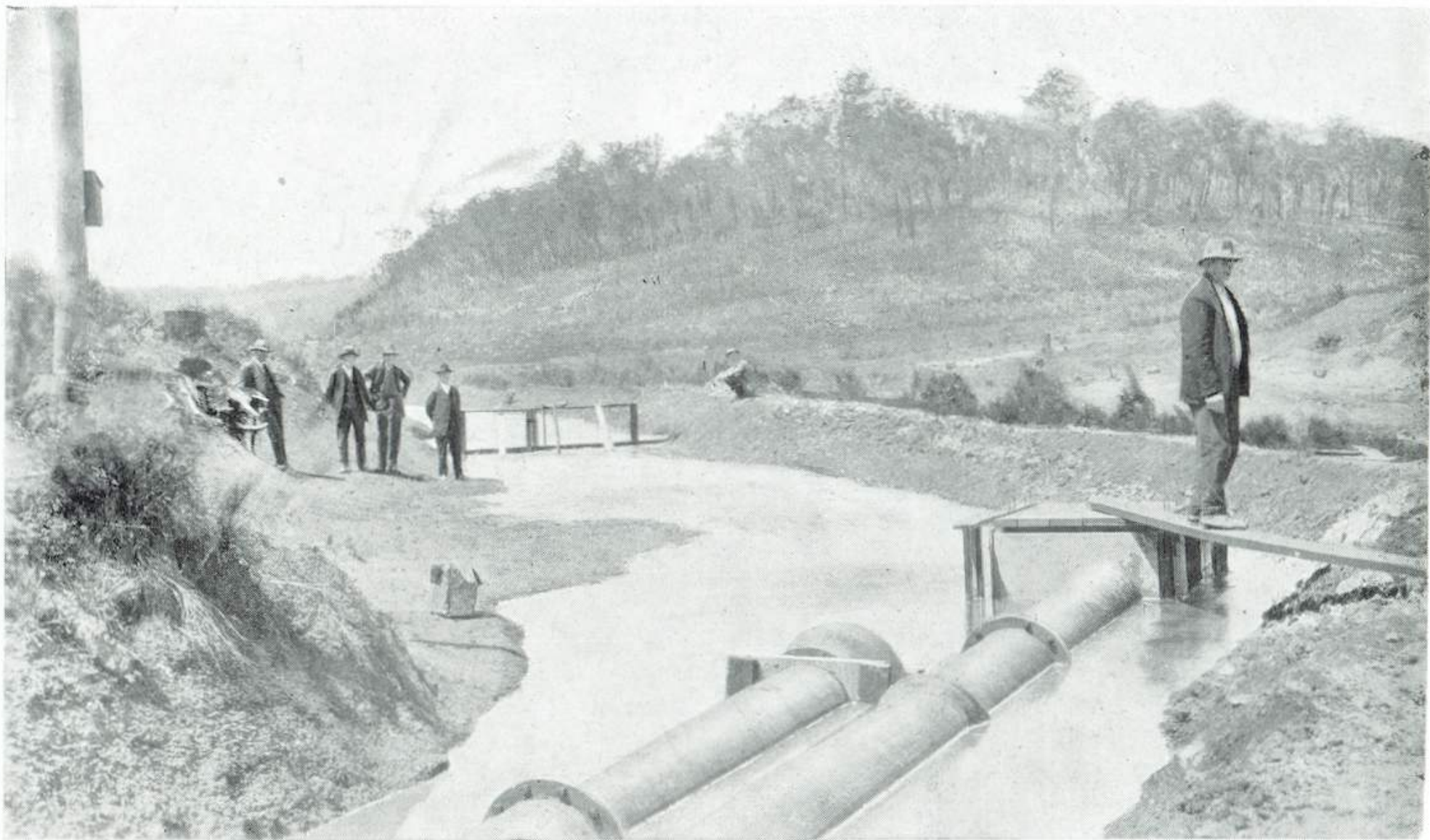
CHURCHMAN BROOK RESERVOIR (UNDER CONSTRUCTION).

(Capacity 512,000,000 gallons. Height of Dam Wall, 70 feet.) View from East side of Valley showing temporary Diversion Weir, Camps, etc.



CHURCHMAN BROOK DIVERSION WEIR—DOWNSTREAM.





### FIRST SUPPLY FROM THE NEW HILLS SCHEME.

*In November, 1925, the water from Churchman's Brook was diverted into the 16-in. main as shown in above photograph.  
16-in. main is laid from Churchman's Brook Reservoir site to junction at Canning River.*





GAUGING WEIR AT WUNGONG BROOK AND APPROXIMATE SITE OF WUNGONG RESERVOIR.





## HILLS WATER MAIN.

*Unloading 36-in. Pipes from Railway trucks to Motor lorry and trailer.*





36-IN. HILLS WATER MAIN—PIPELAYING.





30-IN. HILLS WATER MAIN.  
*First crossing of Canning River at Roleystone.*

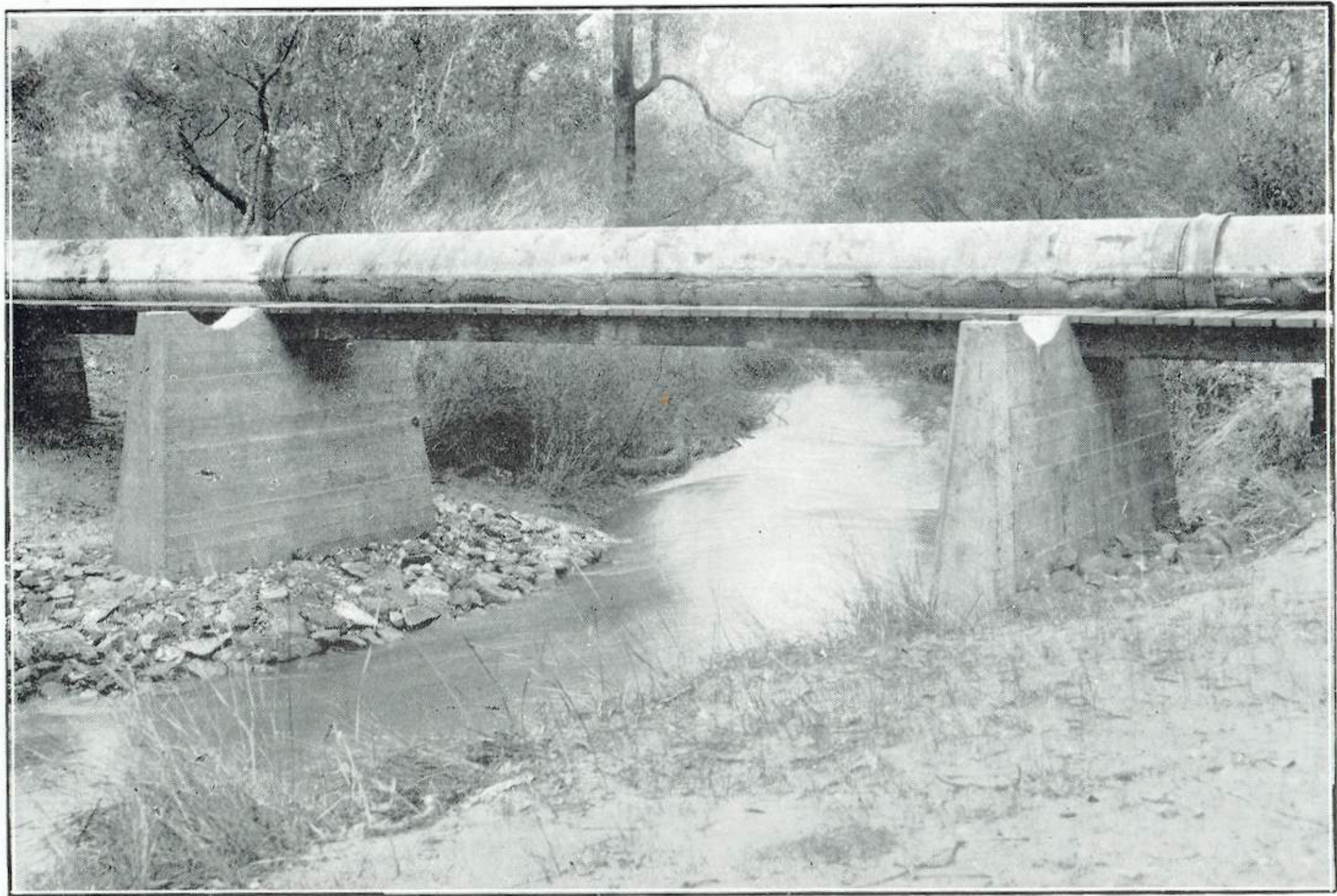




30-IN. HILLS WATER MAIN.

*Second crossing of Canning River at Roleystone, looking towards Perth ; provision made for future 36-in. pipe.*





30-IN. HILLS WATER MAIN.

*Third crossing of Canning River at Kelmscott, showing middle piers.*

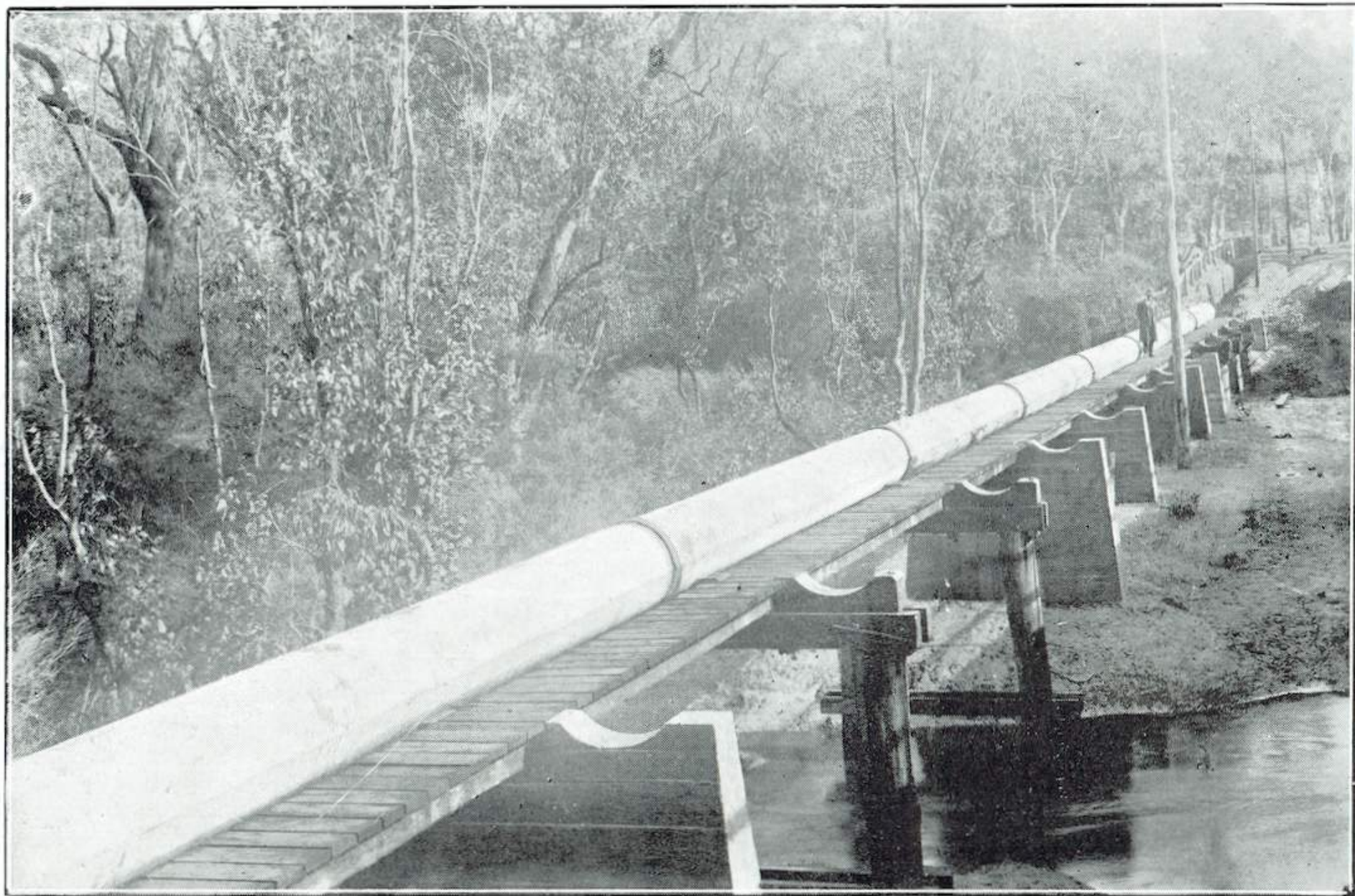




30-IN. HILLS WATER MAIN.

*Third crossing of Canning River at Roleystone, looking up River : provision made for future 36-in. pipe.*

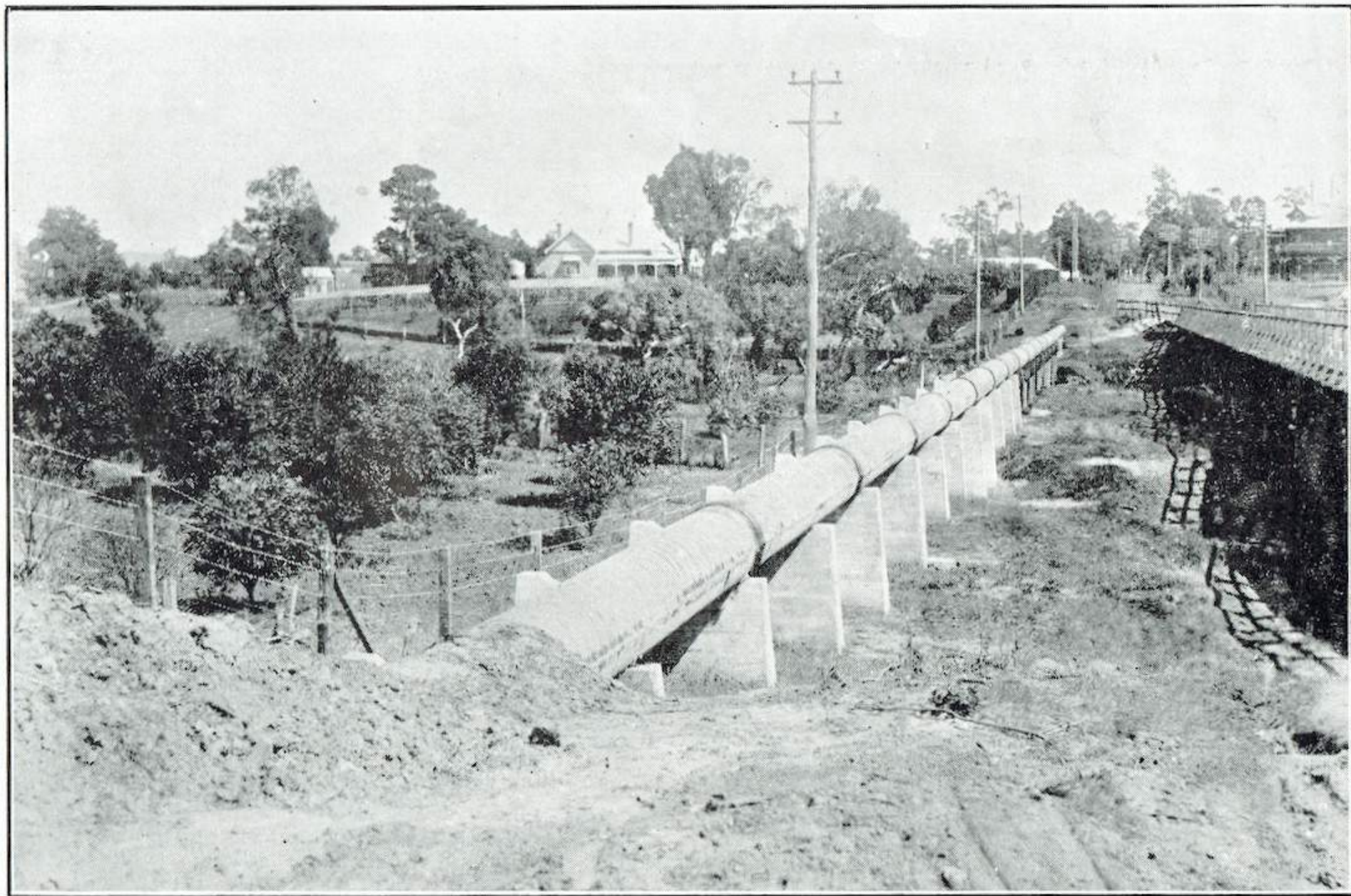




30-IN. HILLS WATER MAIN.

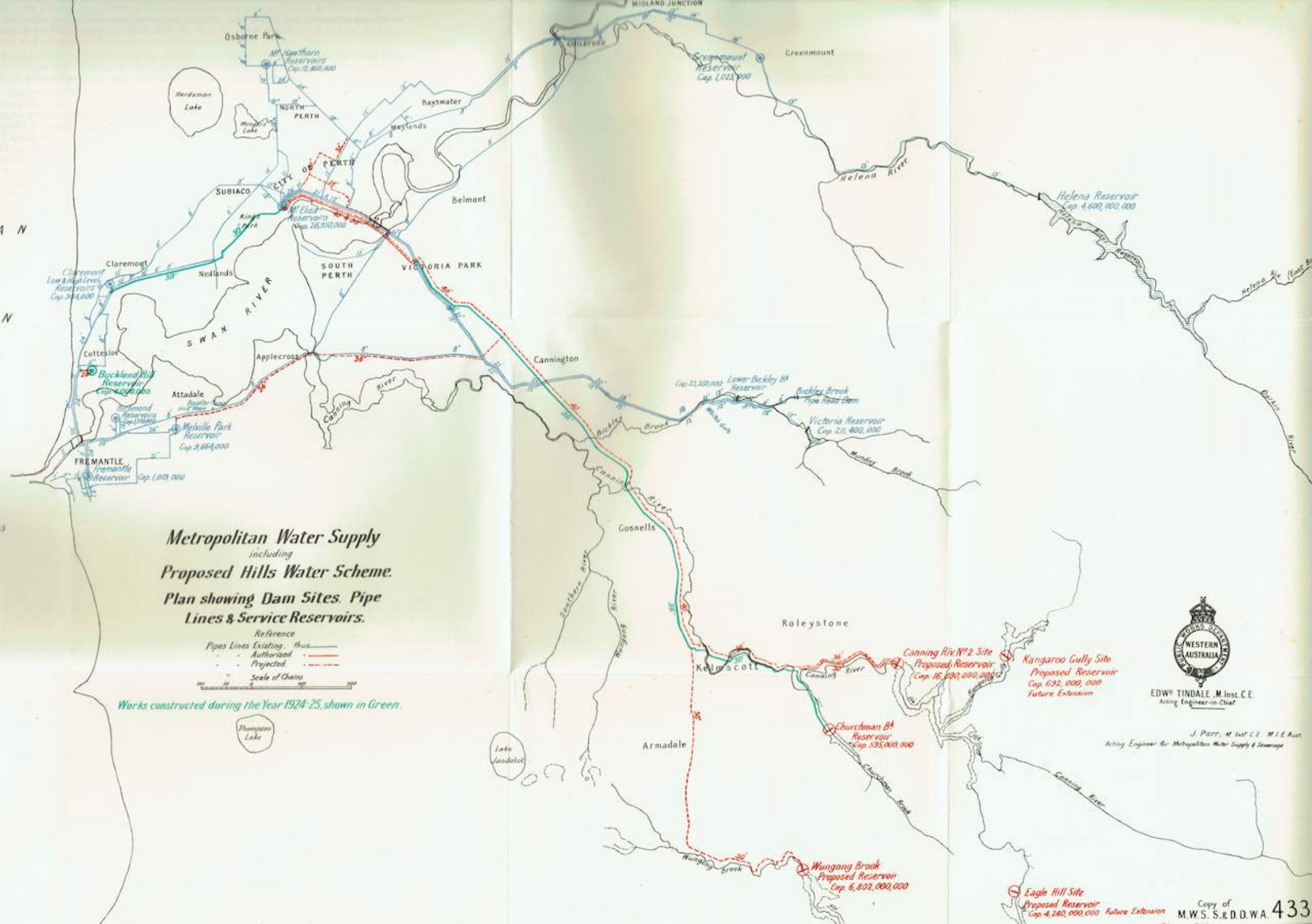
*Crossing of Canning River at Kelmscott, showing concrete and timber piers.*





HILLS MAIN—CROSSING OF CANNING RIVER AT GOSNELLS.





**Metropolitan Water Supply**  
including  
**Proposed Hills Water Scheme.**  
**Plan showing Dam Sites, Pipe**  
**Lines & Service Reservoirs.**

Reference  
Pipes Lines Existing, thus  
- - - - -  
- - - - -  
- - - - -  
- - - - -  
Scale of Chains  
0 100 200 300

Works constructed during the Year 1924-25, shown in Green.



EDWARD TINDALE, M. Inst. C.E.  
Acting Engineer-in-Chief

J. PARR, M. Inst. C.E., M.I.E. Aust.  
Acting Engineer for Metropolitan Water Supply & Sewerage

# Metropolitan Sewerage System.

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In March, 1895, the Perth Local Board of Health forwarded a memorandum to the Premier, Sir John Forrest, on the subject of a sewerage system for the City, and urged that necessary legislation be enacted at once to enable a sewerage scheme to be financed and constructed and so do away with the insanitary and objectionable conditions that then obtained.

The Government, already impressed with the necessity for improvement, were at the same time seeking advice, and under the direction of the Engineer-in-Chief (Mr. C. Y. O'Connor) the necessary preliminary work of contour surveys and collection of data was commenced.

In 1897 Mr. Napier Bell, M.Inst.C.E., was commissioned to report on proposals for sewerage of Perth and Fremantle. He recommended that the sewage of Perth should, after settlement in tanks, be discharged into the Swan River about 60 chains above the Bunbury Railway Bridge, and that provision should be made so that as the city developed the sewage might be conveyed to a sewage farm at Cannington. For Fremantle Mr. Bell recommended that the sewage, after similar settlement, should be discharged into the sea south of the town, and that at North Fremantle the sewage be discharged without treatment into the river at Rocky Bay.

In 1898 Mr. T. C. Hodgson, Engineer for Sewerage, proposed a scheme to discharge the sewage of Perth into the ocean and this scheme, estimated to cost £370,000, was recommended for adoption by a conference held at the City Council Chambers. Shortly after this Mr. C. S. R. Palmer, who succeeded Mr. Hodgson as Engineer for Sewerage, proposed the consideration of the bacterial method of treating the sewage, and in 1901 a practical test of this method was made by the construction of a septic tank and filter at Government House. The bacterial experiments proving successful, Mr. Palmer (then Engineer-in-Chief) instructed the Engineer for Sewerage, Mr. Hugh Oldham, to prepare schemes for the treatment of the sewage of the City and Fremantle by this method.



These schemes were submitted in 1903 to Mr. J. Davies, M.Inst.C.E., of the Public Works Department, New South Wales, and generally endorsed by him. In the same year the "Metropolitan Water Supply and Sewerage Act" was passed and the preparation of detail plans for the sewerage works commenced.

In 1904 a sewerage system with septic tanks and percolating filters, designed on the principles proposed for the city scheme, was constructed at the Railway Workshops, Midland Junction, and proved highly successful.

The plans for the Metropolitan Scheme, were completed in 1905 and approved by Mr. Davies. Construction of the works was authorised by the Government in 1906 and commenced in June of that year.

In consequence of adverse criticisms a Royal Commission was appointed in June, 1909, to inquire into the methods of construction and supervision. The Commissioners were Mr. Calder E. Oliver, M.C.E., M.Inst.C.E., Engineer-in-Chief, Melbourne and Metropolitan Board of Works (Chairman), Mr. Thomas Walker-Fowler, M.Inst.C.E., M.Am.Soc.C.E., and Mr. John Gahan, Vice-Chairman Sewerage Committee, Melbourne and Metropolitan Board of Works. The findings of the Commission were that the works had been well constructed and supervised and that any defects were insignificant in regard to the magnitude of the works.

The first section of the Sewerage Works of Perth was brought into operation in January, 1912.

The system provides for keeping the sewage entirely independent of the stormwater, such separation being essential for the bacterial treatment of the sewage.

The sewage treatment works comprise septic tanks situated at Claisebrook, East Perth, and percolating filters on the opposite side of the river at Burswood.

There are four septic tanks, each 100ft. x 50ft. x 10ft. deep, built of reinforced concrete.

The effluent from the tanks flows through a syphon of C.I. pipes under the Swan River to the filter beds on Burswood Island, and after filtration passes through settling pits and thence into the



river. There are ten filter beds each 100ft. in diameter x 6ft. deep now in operation, each built on a reinforced concrete foundation, supported by piles. The effluent is distributed over the surface of the filters by means of revolving sprinklers.

The main sewer, 3ft. 3in. x 2ft. 2in. oval section, follows the Claisebrook Valley from the septic tanks to Monger's Lake, reducing in size gradually to 1ft. 3in. x 10in.

There are four main branch sewers which flow into the main sewer at various points along its course.

The main sewer is constructed of Monier reinforced concrete pipes.

The sewage from the low level area along the foreshore of the Swan River, which cannot be gravitated to the Treatment Works, is pumped. Three pumping stations (at Mill Street, Hill Street, and the Causeway) with electrically driven pumps, automatically controlled, deal with the sewage from this area and deliver it direct into the Terrace branch sewer.

The sewage of Fremantle is collected in a main sewer starting from East Fremantle and traversing southwards through Fremantle and South Fremantle to three septic tanks situated near the Smelting Works, and the effluent from the tanks flows to an outfall pipe discharging into the sea under Robb's Jetty.

The sewage from the low level areas in Fremantle is pumped into the main sewer from four stations—Wardie Street, Essex Street, Market Street, and James Street—all electrically operated and automatically controlled.

A scheme for the sewerage of the Subiaco District is now under construction. Two sections of the main sewer are completed and the ocean outfall is in progress. The sewage will be treated at works on Swan Location 714, about three-quarters of a mile from West Subiaco Station, and the effluent therefrom will discharge through a 42in. diameter reinforced concrete outfall direct into the ocean. This outfall pipe is designed to deal with both sewage and stormwater drainage from Subiaco.



# Sewerage Statistics.

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Area served—Perth	....	....	....	3,197	acres
Fremantle	....	....	....	1,208	„
Total	....	....	....	4,405	<u>acres</u>

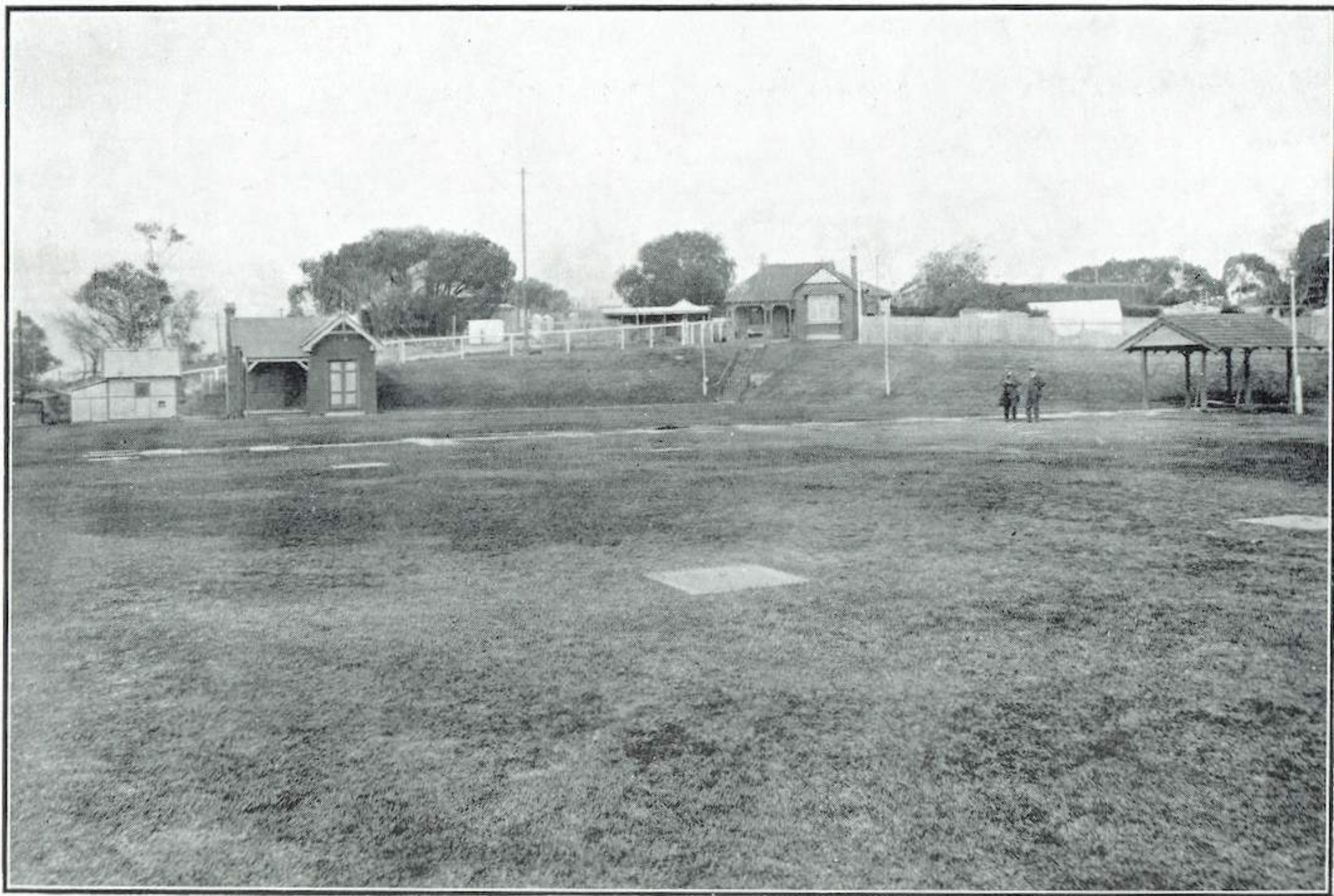
No. Pumping Stations—Perth 3, Fremantle 4.

No. Septic Tanks—Perth 4, Fremantle 4.

No. Filter Beds—Perth 10.

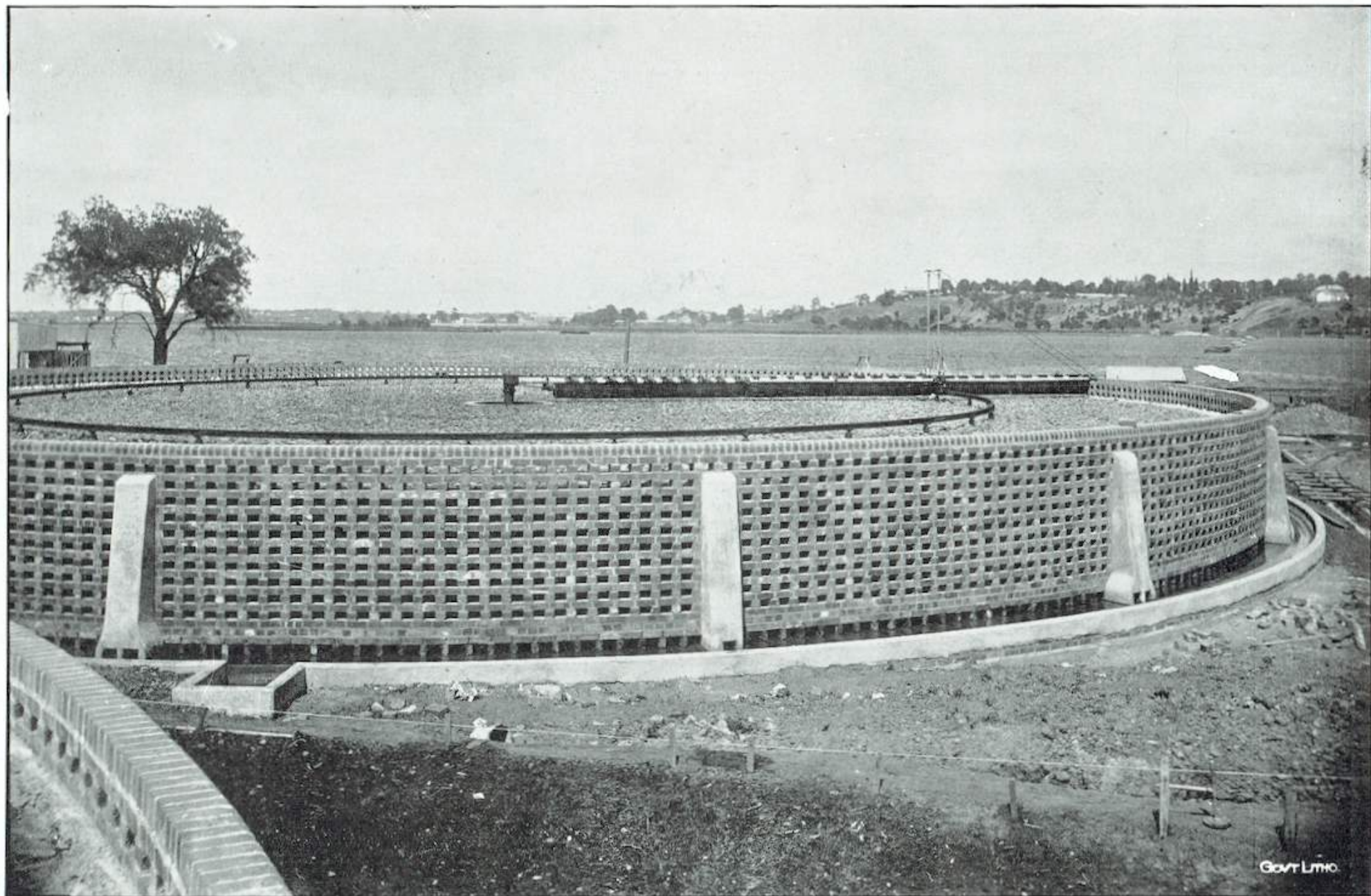
Average Daily Flow, Gallons—Perth	....	1,695,427
Fremantle	....	492,307

			<u>1912.</u>		<u>1925.</u>
Length Sewers laid—Miles	....	....	53.25	....	136.85
No. Houses sewered	....	....	1,227	....	15,678
Population served	....	....	5,030	....	75,000
Sewage treated—Gallons—					
Perth	....	....	133,646,000	....	618,831,000
Fremantle	....	....	19,100,000	....	179,772,000



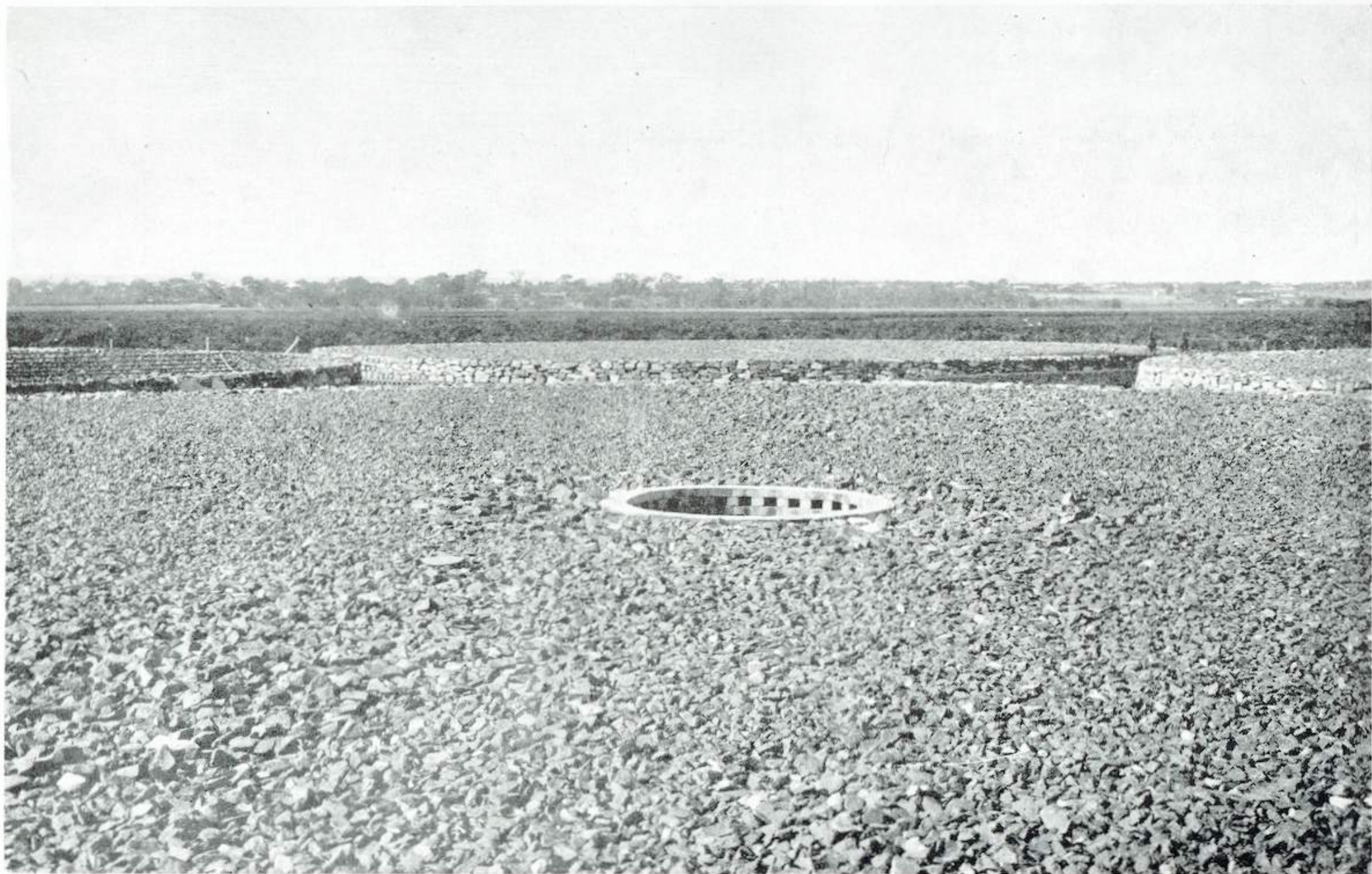
SEWAGE TREATMENT WORKS, CLAISEBROOK, EAST PERTH.





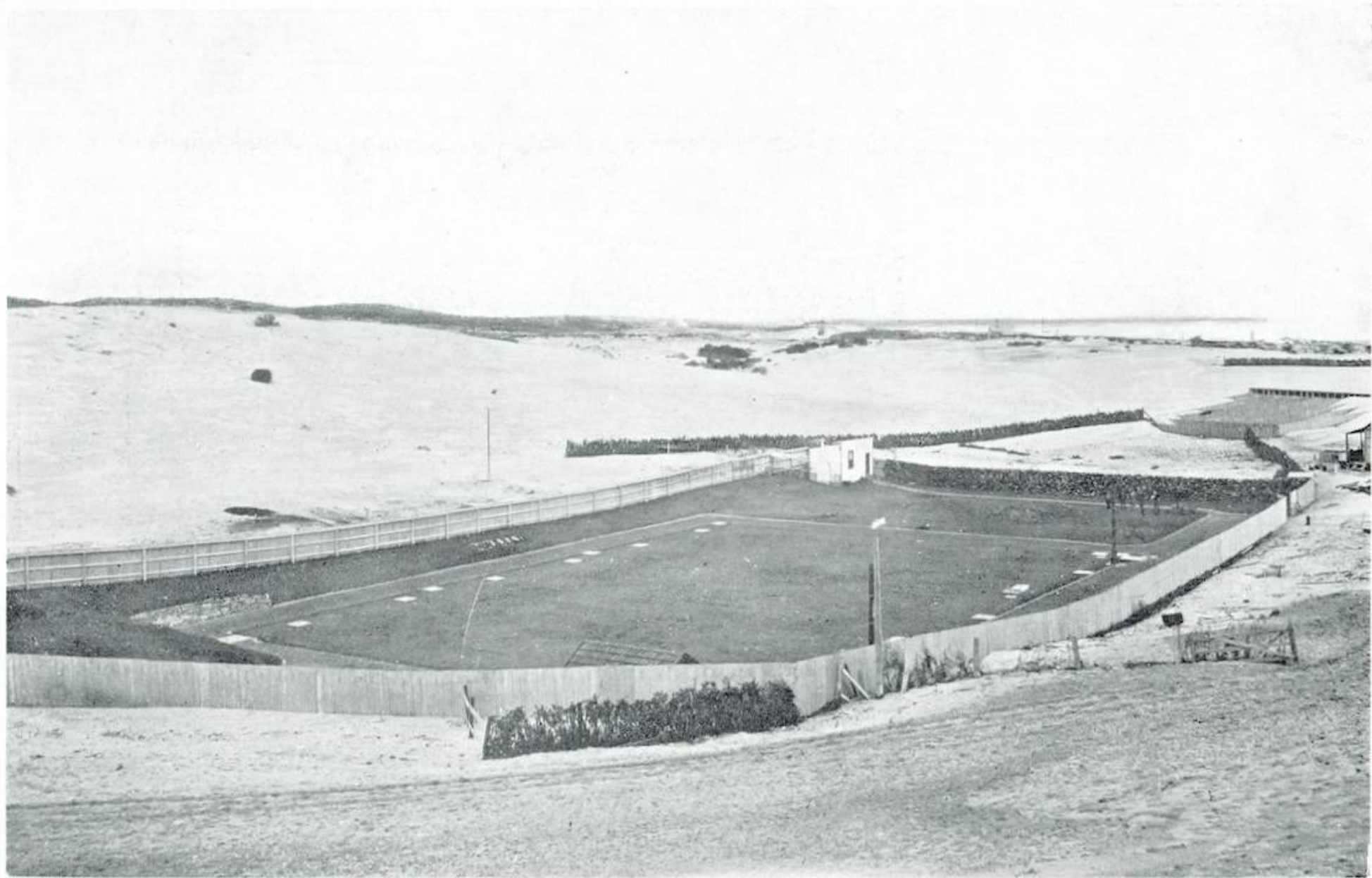
PERTH SEWAGE TREATMENT WORKS, FILTER BED, BURSWOOD ISLAND.





ANOTHER VIEW OF SEWAGE FILTER BEDS, BURSWOOD ISLAND.



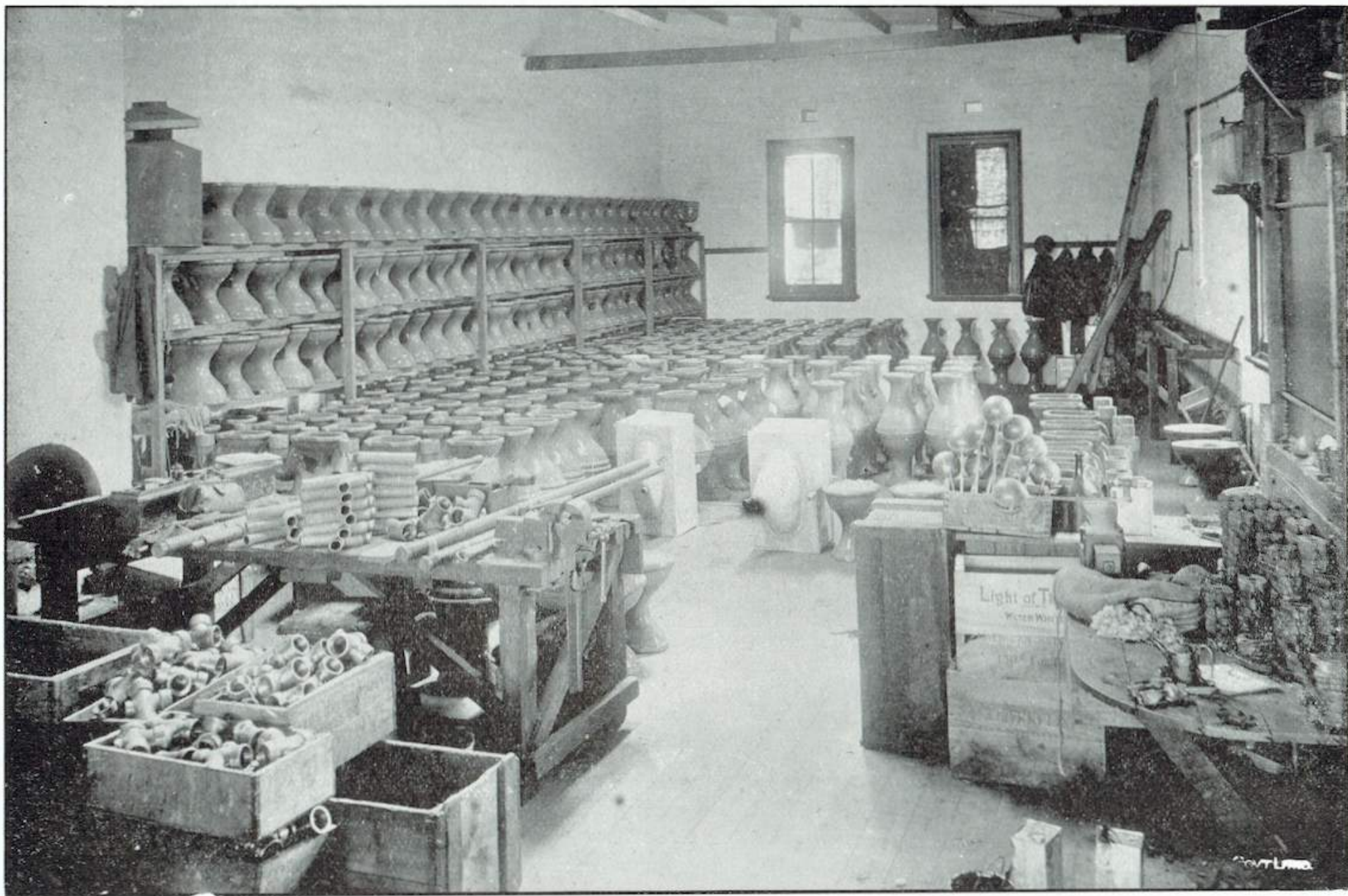


SEPTIC TANK, FREMANTLE.



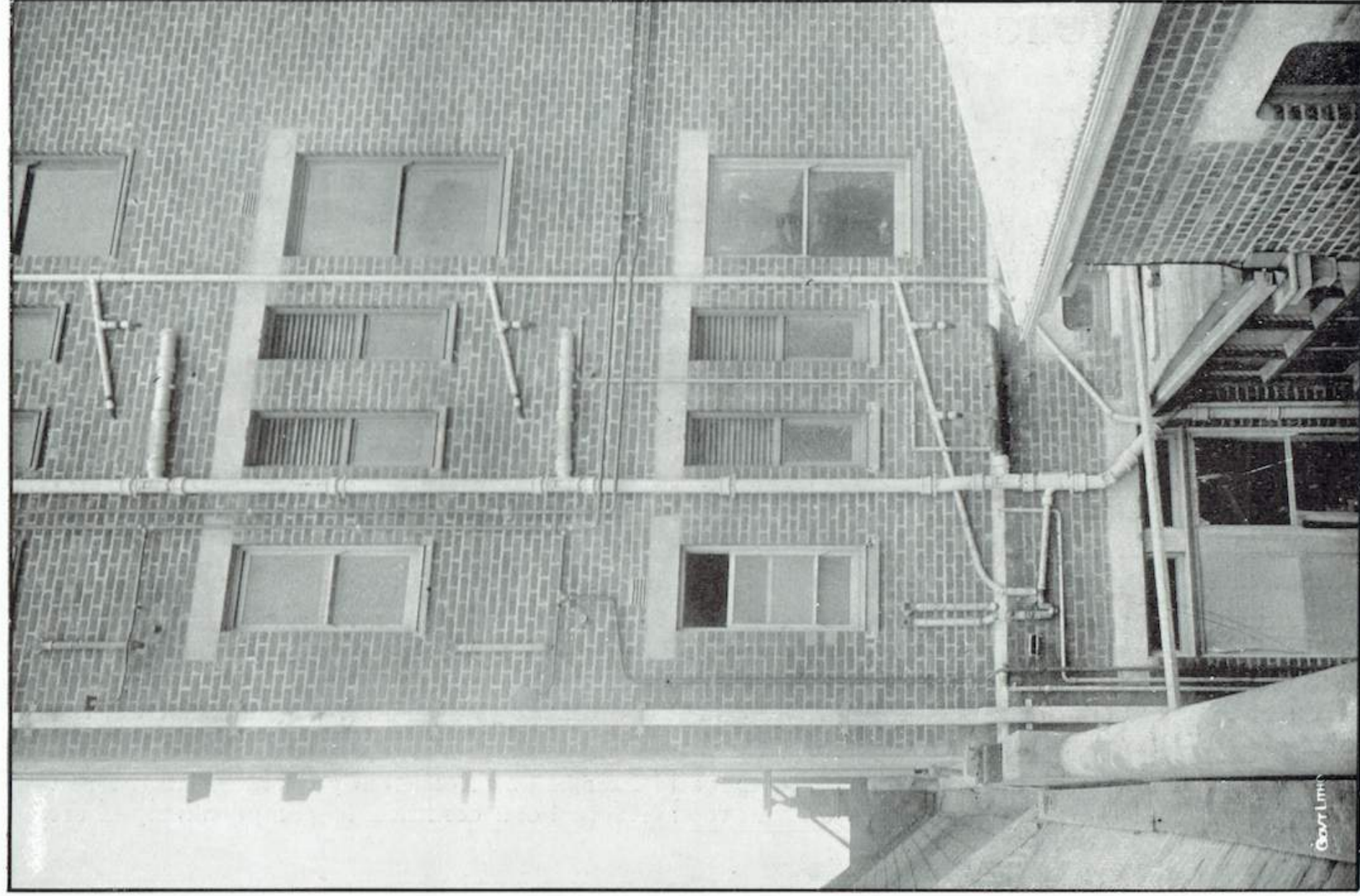
TYPE OF SEWAGE LOW LEVEL PUMPING STATION.  
*Six of these Stations are provided for Low Level Areas in Perth and Fremantle.*





SEWERAGE AND WATER SUPPLY FITTINGS, ETC.—TESTING ROOM.





TYPICAL VIEW OF EXTERNAL PLUMBING.  
SEWERAGE AND WATER SUPPLY.



## Metropolitan Stormwater System.

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The first provision for stormwater drainage in Perth was made by the City Council, the Wellington Street drain which ended in Claisebrook Road being the principal feature. The drain is 5ft. 3in. diameter at Wellington Street and increases to 8ft. 6in. at Claisebrook Road. It was taken over by the Government in June, 1916.

In 1908 the Government constructed a large stormwater drain extending from Royal Street *via* Lord and Parry Streets to Vincent Street, near Smith's Lake, and in the same year a branch therefrom to Hyde Park, and extended the latter to North Perth in 1918.

The necessity for relieving the Wellington Street drain, and improving the drainage of the low lying parts of West Perth, was provided for by the construction of the Mount's Bay Main Drain in 1907. This drain, starting from Spring Street, passes under St. George's Terrace and Hay Street at a depth of about 60 feet and taps the Leederville Valley near the West Perth Railway Station, and continues to Monger's Lake.

In 1910 the Government constructed the Mt. Lawley stormwater main drain from Field Street, *via* Walcott, Beaufort, and Barlee Streets and Forrest Park to Walters Brook.

For the drainage of portions of West Perth, Leederville, and Subiaco a main stormwater drain was constructed by the Government in 1908, extending from Olive Street to a point between Jolimont and the Railway. This drain will be extended in the future to discharge into the ocean through the outfall that is now being constructed to provide for this drainage and also for the effluent from the Subiaco Sewage Treatment Works.

The natural slopes of the more populous areas of Fremantle afford ready drainage to the sea or to the river and the main drainage works have therefore been confined to comparatively short

drains discharging thereto. The extension of the drainage system to carry away the stormwater from the valleys immediately East of Fremantle and South Fremantle will require a large drain to be constructed by tunnelling from the ocean frontage through the intervening limestone ridge.

In 1922-23 a reinforced concrete pipe drain was constructed along Bay View Terrace, Claremont, to the Swan River at Freshwater Bay, with a branch along Princess Road, a total length of over 2,000 feet, and capable of discharging at the rate of 22,000 gallons per minute. This drain serves the purpose of draining a fairly large area of the Claremont District.

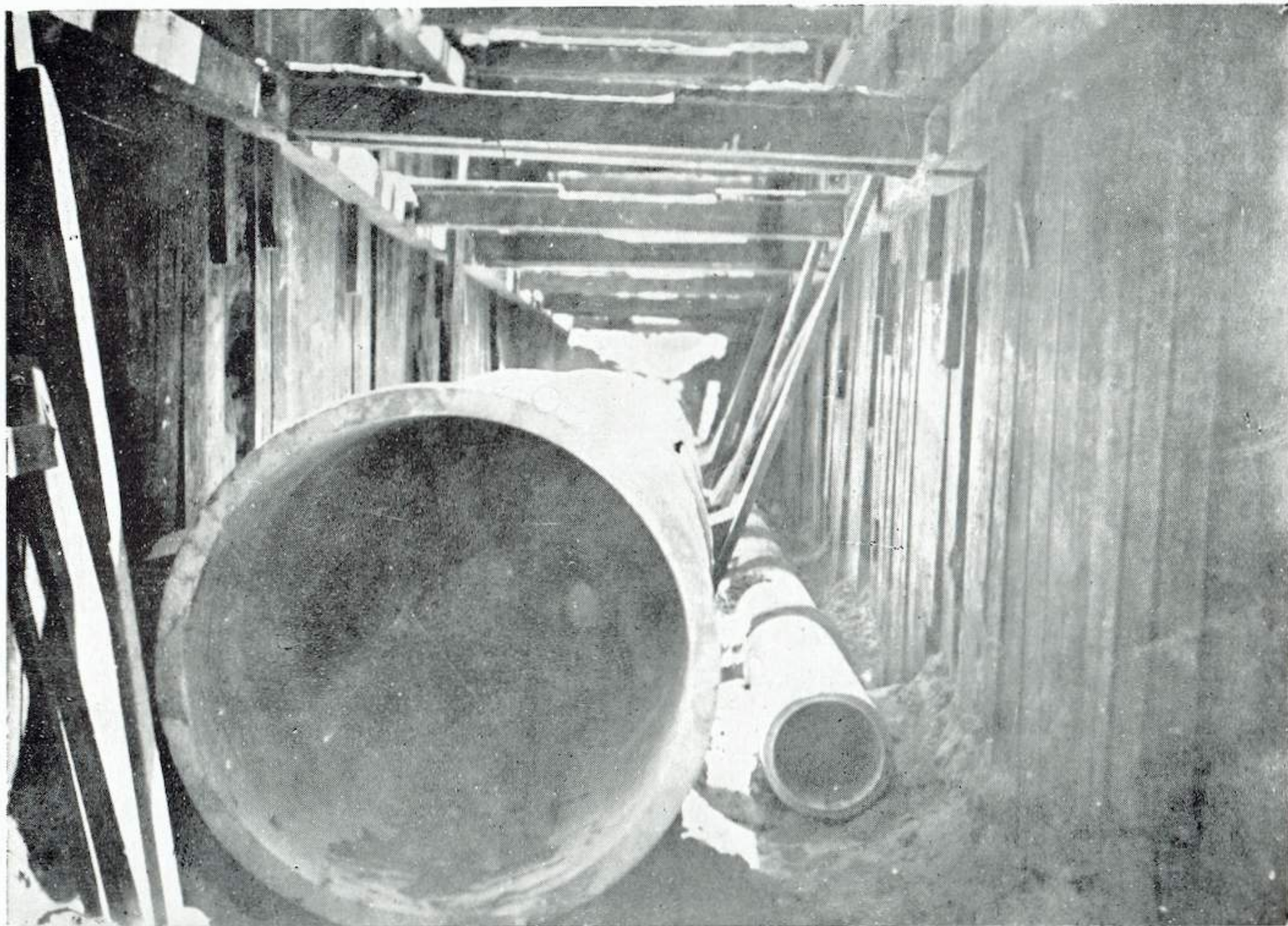


## Stormwater Drainage Statistics.

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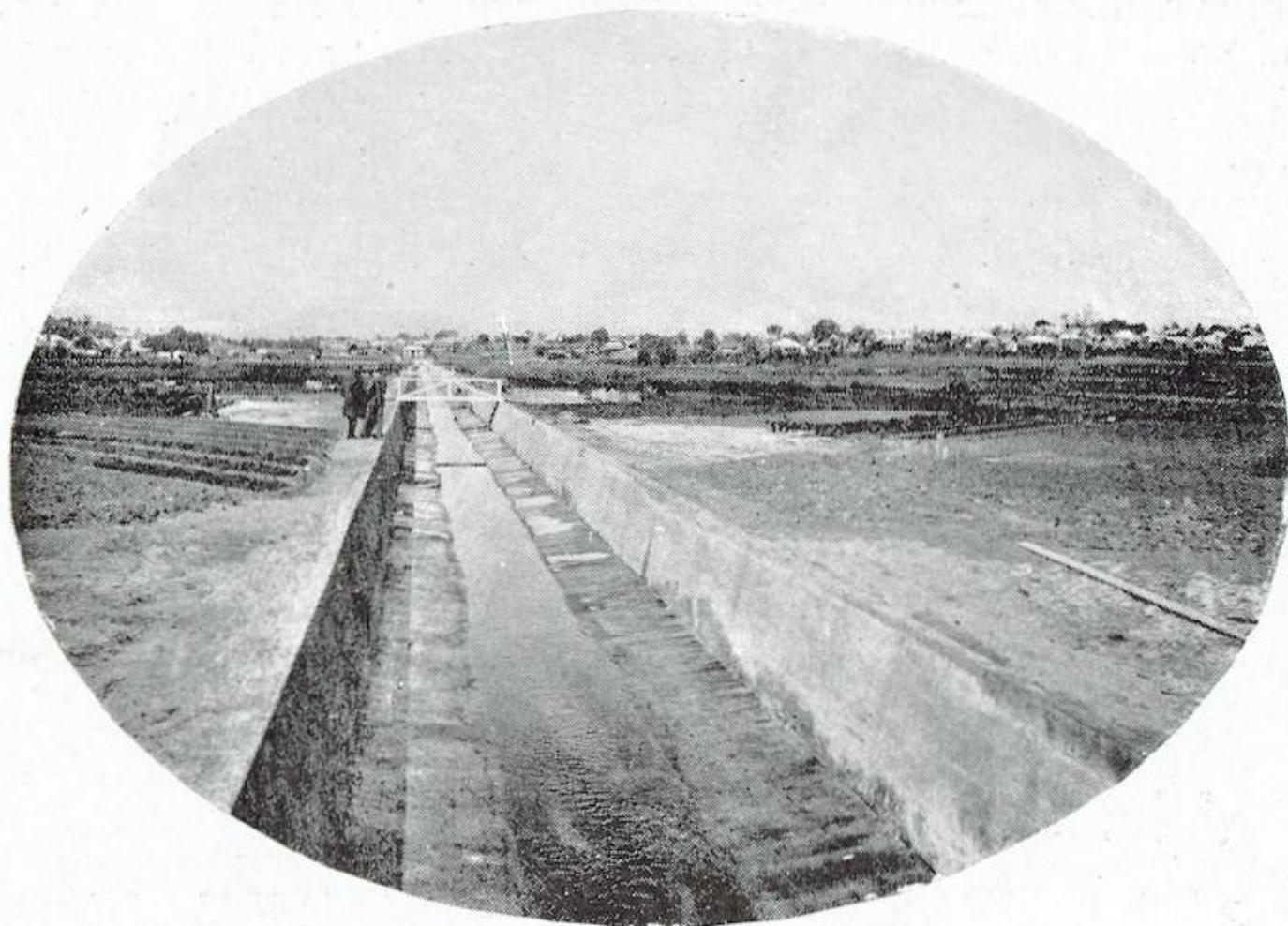
						<u>1912.</u>		<u>1925.</u>
Area served by drains—Acres	....	....	....	....	....	4,583	....	6,161
Length of Drains laid—Miles	....	....	....	....	....	7.25	....	19.87





STORMWATER DRAIN AND SEWER.





OPEN STORMWATER DRAIN.